Infrastructure as an investment

Private Markets

1 A story: the only bridge in town

- Essential service: people must use it
- Lasts for decades, hard to copy
- Fees can rise with inflation
- But a bridge not yet built is riskier

IN THE LESSON

- Picture a town with one bridge across a wide river.
- Everyone who wants to cross must use it, rain or shine, recession or boom.
- Nobody can build a second bridge next door, because the cost is huge and the council would never allow it.
- Whoever owns the right to run that bridge collects a steady fee, for decades, and the fee can rise with prices.
- That is the heart of infrastructure.
- Mira Okafor likes it for exactly that reason, because her plan owes pensions for decades and wants income that lasts as long.
- But she knows a bridge nobody has built yet, or one that few people use, is a very different animal.

2 The key characteristics

- Essential services, fairly inelastic demand
- Assets last for decades
- High barriers: monopoly, regulation, concession
- Long term cash flows, often linked to inflation

IN THE LESSON

- Let us list what makes infrastructure special.
- First, it provides essential services, so demand is fairly inelastic, meaning it barely changes when prices change.
- Second, the assets last for decades.
- Third, there are high barriers to entry.
- A natural monopoly, a regulator or a government concession keeps competitors out.
- Fourth, the cash flows are long term and often linked to inflation, through indexed tariffs or contracts.
- Together these give income that is steady and predictable, with low sensitivity to the economic cycle.
- That is the typical picture.
- Hold on to the word typical, because the next few slides show how often a particular asset breaks the pattern.

3 Kinds of infrastructure and how they earn

Two families of assets, three ways to earn

Type	Examples and revenue
Economic	Transport, utilities, energy, communications
Social	Schools and hospitals: availability payments
Regulated or contracted	Tariff set, or long contract signed
Demand based	Tolls: income follows the traffic

IN THE LESSON

- Now the main kinds.
- Economic infrastructure supports the economy: transport such as roads, rail, airports and ports, utilities such as water and electricity networks, energy such as pipelines and power plants, and communications such as towers and cables.
- Social infrastructure serves the community: schools, hospitals, prisons and similar public buildings.
- Social assets are often paid through availability payments, where the government pays a fee simply because the building is open and in good condition, whatever the number of users.
- The revenue itself comes in three flavours.
- Regulated, where a regulator sets the tariff.
- Contracted, where a buyer signs a long contract.
- And demand based, as with tolls, where income depends on how many people turn up.

4 Greenfield and brownfield

Revenue model against stage of life

Revenue model, stage	Risk level
Regulated or contracted, brownfield	Lowest risk
Regulated or contracted, greenfield	Construction risk
Demand based, brownfield	Volume risk
Demand based, greenfield	Equity like

IN THE LESSON

- Next, the stage of life.
- A greenfield asset is still to be built, or only just built.
- It carries construction risk, and nobody yet knows whether the traffic or the customers will arrive.
- A brownfield asset is already operating, with a record of cash flow that a buyer can inspect.
- Investors usually pay more for the certainty of brownfield and earn less.
- Greenfield pays more because it asks the investor to carry the risk of building and ramping up.
- This second dimension matters as much as the first.
- A regulated or contracted brownfield asset, such as a running grid, is at the safe end.
- Greenfield with a contract adds construction risk.
- A running toll road carries volume risk.
- And a new airport, still to be built and depending on passengers, behaves like equity.

5 Example 1: one recession, three assets

Revenue 100, costs 30.9 after inflation, debt service 40; normal year pays equity 30

Hospital: revenue 103	103 − 30.9 − 40	**32.1 (+7%)**
Toll road: revenue 92.7	92.7 − 30.9 − 40	**21.8 (−27%)**
Airport: revenue 80	80 − 30.9 − 40	**9.1 (−70%)**
Toll revenue	100 × 0.90 × 1.03	**92.7**

IN THE LESSON

- Let us test the idea with numbers.
- Three assets each earn revenue of one hundred, pay operating costs of thirty that rise with three per cent inflation, to thirty point nine, and pay fixed debt service of forty.
- In a normal year that leaves thirty for the owners.
- Now a recession arrives, with inflation of three per cent.
- The hospital gets an indexed availability payment, so revenue rises to one hundred and three, and the owners receive thirty two point one, up seven per cent.
- The toll road's tolls rise three per cent but traffic falls ten per cent, so revenue is ninety two point seven and equity gets twenty one point eight, down twenty seven.
- The airport loses twenty per cent of passengers, with charges flat, so equity gets nine point one, down seventy.
- Three assets, one recession, three very different results.

6 Cash to equity in the same recession

Cash to equity

Hospital	**32.1**
Toll road	**21.8**
Airport	**9.1**

Normal year: 30 for each

IN THE LESSON

- Here is that result as a picture.
- The vertical axis is cash paid to the owners, in the same units as the example.
- In a normal year every asset pays thirty.
- Now look at the three bars.
- The hospital, on the left, pays thirty two point one.
- It rose, because its payment is indexed to prices and does not depend on how many patients visit.
- The toll road is in the middle at twenty one point eight, hurt by falling traffic.
- The airport on the right is only nine point one.
- Same label, infrastructure, and three very different outcomes.
- The revenue model, not the label, sets the risk, and this is the most useful sentence in the whole lesson.

7 The main risks, and the trap

- Regulatory and political change
- Construction: late or over budget
- Demand, refinancing and ESG risk
- Trap: not all infrastructure is low risk

IN THE LESSON

- Every infrastructure asset faces some mix of five risks.
- Regulatory and political risk: a regulator can cut the tariff, or a government can change the rules or cancel a contract.
- Construction risk: the project may be late or over budget.
- Demand risk: fewer users than forecast.
- Refinancing risk: the debt falls due and cannot be replaced on good terms.
- And environmental, social and governance risk, which can bring stranded assets, fines or community opposition.
- Now the exam trap.
- It is to assume all infrastructure is low risk.
- Greenfield projects, and assets that depend on the economy, such as airports and ports, can behave much more like company shares than like bonds.

8 A story: three ways to own a pub

- Buy it yourself: control, but big and hard
- Join a syndicate: sells in 10 years
- Buy listed shares: small and liquid
- Choose by size, liquidity, skill and fees

IN THE LESSON

- Suppose you want a share of the profits from pubs.
- You could buy a pub yourself.
- You get full control, you choose the landlord, and you keep it as long as you like, but you need a lot of money and some knowledge of pubs.
- Or you could join a syndicate that buys several pubs and agrees to sell them all in ten years.
- Cheaper, spread out, but you play by their timetable.
- Or you could buy shares in a listed pub company: small amounts, easy to sell, but the price jumps around with the stock market.
- Mira Okafor faces the same menu for infrastructure, and the right choice depends on size, liquidity needs, governance capacity and fees.

9 Unlisted routes in

Unlisted equity routes and what each suits

Route	Suited to
Direct	Large investor with a specialist team
Closed end fund	Diversified, fixed life of about 10 years
Open ended fund	Core assets held for the long run
Co investment	Lower fees, if able to act quickly

IN THE LESSON

- Here are the unlisted routes.
- Direct investment means the plan buys the assets itself.
- It gains control and can hold for as long as it likes, but it needs a specialist team and the scale to write very large cheques.
- An unlisted closed end fund pools investors' money, with a manager who buys assets and sells them within a fixed life, often around ten years.
- It gives access and diversification, but that fixed life is short next to the life of the assets.
- An open ended or evergreen fund has no end date, so it suits core, long hold assets.
- A co investment sits beside a fund, usually at lower fees, but the investor must move fast.

10 Listed routes, partnerships and debt

Other ways in

Route	Suited to
Listed company or fund	Liquidity and small tickets
Exchange traded fund	Cheap, easy, moves with markets
Partnership with government	Build or run under a concession
Project loans and bonds	Contracted income, less upside

IN THE LESSON

- Now the other routes.
- Listed infrastructure companies, listed funds and exchange traded funds give liquidity and small ticket sizes.
- A plan can buy a few million, and sell tomorrow.
- But they carry stock market volatility, so they are a poor match for an investor who wants smooth reported values.
- A public private partnership is an arrangement under which private capital builds or runs a public asset under a concession, and is paid by the government or by users.
- And an investor can skip equity and take debt exposure: project loans or project bonds, which pay contracted interest and sit ahead of the owners in the queue.
- Debt gives income with less upside.

11 The trap: fund life against asset life

Years

Fund life	**10 years**
Asset life	**30 years**
Left at sale	**20 years**

Sale is forced on the fund's timetable

IN THE LESSON

- Now the trap for closed end funds.
- The vertical axis is years.
- The first bar is the fund's life, ten years.
- The second bar is the useful life of the asset it buys, which for a long lived pipeline or port might be thirty years.
- When the fund reaches the end of its term, it must sell, even though the asset has twenty years of income left.
- The sale happens on the fund's timetable, not the asset's, and the buyer may pay less if markets are weak.
- Compare an open ended fund, which can keep a core asset for as long as it earns.
- So the fixed life is a feature for a value added strategy but a mismatch for core assets.

12 Example 2: building Alder Ridge's sleeve

Plan 8,000m; sleeve 5%; one direct stake costs 300m

Sleeve size, and one direct stake	5% × 8,000; 300 ÷ 400	**400m; 75%**
Open ended core fund, 70%	fee 0.9%: 2.52m	**280m**
Closed end value added, 20%	fee 1.5%: 1.20m	**80m**
Listed, 10%	fee 0.4%: 0.16m	**40m**
Blended fee	(2.52 + 1.20 + 0.16) ÷ 400	**0.97%**

IN THE LESSON

- Back to the plan.
- It has eight billion and wants five per cent in infrastructure, which is four hundred million.
- It has no direct investment team, and one direct stake would cost three hundred million, which is seventy five per cent of the sleeve in a single asset.
- So Mira Okafor rules out direct.
- She puts seventy per cent, two hundred and eighty million, in an open ended core fund, which suits long held assets.
- Twenty per cent, eighty million, goes into a closed end value added fund for extra return.
- And ten per cent, forty million, goes into listed infrastructure, which gives liquidity for rebalancing.
- With fees of point nine, one point five and point four per cent, the blended fee is about point nine seven per cent.
- That is the price of the whole sleeve.

13 Choosing a route: the rule of thumb

- Size: scale and team, or use funds
- Liquidity: some listed for rebalancing
- Governance and fees: can the board act fast?
- Match the vehicle's life to the asset's life

IN THE LESSON

- So how does Mira Okafor choose?
- Start with size.
- Direct investment needs scale and a team, so most plans of her size go through funds.
- Then liquidity.
- If the plan may need to sell or rebalance, hold some listed infrastructure, but accept the volatility.
- Then governance.
- Co investments and direct deals require quick decisions, and a small board that meets quarterly cannot make them.
- Finally the fee budget: co investments and listed vehicles are cheaper, closed end funds with performance fees are dearer.
- And match the vehicle to the asset.
- Core assets with long lives belong in open ended funds, riskier value added assets in closed end funds whose fixed life matches a plan to improve and sell.

14 A project's life and its funding

From idea to operation

Develop: equity → Build: construction loans → Operate: stable cash

After construction

Refinance: cheaper debt → Hand back at the end

IN THE LESSON

- Now follow a single project through its life, because the right money changes at each stage.
- In the first row, development comes first: permits, design and bidding.
- This is the riskiest phase because it may come to nothing, so it is paid for with equity.
- Next is construction, under a fixed price contract, but still exposed to delays and overruns, so lenders provide construction loans on careful terms.
- Then operation, where the asset earns stable cash flow.
- In the second row, once construction risk has passed, the project can be refinanced on cheaper terms.
- And under a concession, the asset is eventually handed back to the government.
- Risk falls as you move along the line.

15 What debt and equity each contribute

The project company and its two kinds of money

Item	What it means
Debt return	Contractual, paid first
Equity return	Residual, after the lenders
Loss position	Equity takes the first loss
Control	Equity holds it; debt has covenants

IN THE LESSON

- A project usually sits in its own company, called a special purpose vehicle, with one job: own this asset.
- The lenders lend to that company on a non recourse basis, meaning they can look only to the project's cash flows and assets for repayment, not to the sponsor's other businesses.
- That ring fencing is why the structure works.
- So what does each side contribute?
- Debt supplies most of the money and earns a contractual return, interest and principal, which is paid first.
- Equity supplies the rest.
- It takes the first loss, holds control and receives whatever is left after the lenders are paid.
- Because equity is the cushion, it demands a higher return than debt.

16 Sizing the debt

DSCR = CFADS ÷ debt service
Debt = (CFADS ÷ DSCR) × annuity factor

Cash flow for debt service	Cash left to pay lenders
Debt service	Interest plus principal each year
Coverage ratio	Lenders' safety margin
Annuity factor	Turns yearly payments into a loan

IN THE LESSON

- Lenders decide how much to lend using the debt service coverage ratio.
- Debt service is the interest plus the principal repaid each year.
- Cash flow available for debt service is the cash left after operating costs and tax, ready to pay lenders.
- The ratio is the second divided by the first.
- A ratio above one means the project earns more than it needs.
- To size the debt, lenders turn this around.
- They divide the cash flow by the ratio they require, which gives the most debt service the project can bear, and then they multiply by an annuity factor, which converts a level yearly payment over the loan's life into today's amount of debt.

17 Example 3: sizing the debt

Cost 400; CFADS 30 a year; DSCR 1.30; 20 year debt

Maximum debt service	30 ÷ 1.30	**23.1 a year**
Debt at 6%	23.1 × 11.47	**265**
Equity	400 − 265	**135**
Debt refinanced at 5%	23.1 × 12.46	**288**
Released to equity	288 − 265	**23**

IN THE LESSON

- Let us size Alder Ridge's project.
- It costs four hundred and is expected to produce cash flow available for debt service of thirty a year.
- Lenders require coverage of one point three and offer twenty year amortising debt at six per cent.
- Thirty divided by one point three gives maximum debt service of twenty three point one a year.
- The annuity factor at six per cent over twenty years is eleven point four seven, so the debt is about two hundred and sixty five.
- Equity must fund the rest, one hundred and thirty five.
- After construction, refinancing at five per cent uses a factor of twelve point four six, so the same debt service supports two hundred and eighty eight, and twenty three is released to equity.

18 Debt the cash flow supports

Amount

Project cost	**400**
Debt at 6%	**265**
Equity needed	**135**
Debt at 5%	**288**

Same cash flow, cheaper money

IN THE LESSON

- Here is the same project as a picture.
- The vertical axis is the amount of money, against a project cost of four hundred.
- The first bar is the debt that lenders allow at six per cent, two hundred and sixty five.
- That leaves equity to fund one hundred and thirty five, about a third of the cost.
- The second bar is the debt after refinancing at five per cent, two hundred and eighty eight.
- Nothing about the project changed, not its cash flow, not its coverage.
- Only the price of money fell, because the construction risk is behind it.
- The extra twenty three comes back to the owners early, which lifts their return without any new profit.

19 Example 4: the cushion under the lenders

Debt service 23.1 a year; modelled cash flow 30

Cushion before risk	1 − 1 ÷ 1.30	**23%**
Cash flow falls 20%	30 × 0.80 = 24.0	**DSCR 1.04**
Cash flow falls 25%	30 × 0.75 = 22.5	**DSCR 0.97**
Verdict at 25% fall	cash below debt service	**Shortfall**

IN THE LESSON

- Why do lenders insist on a ratio above one?
- Because cash flow can disappoint.
- With coverage of one point three, the cash flow can fall by about twenty three per cent before debt service is at risk, since one minus one over one point three is twenty three per cent.
- If cash flow falls twenty per cent, to twenty four, coverage is one point zero four, thin but still above one.
- If it falls twenty five per cent, to twenty two point five, coverage is point nine seven, and the project cannot pay its lenders in full.
- Equity sits beneath that cushion and takes the shortfall first.
- This is also why leverage is dangerous during construction, when the modelled cash flow does not yet exist.

20 Phase by phase: risk, money and gearing

Matching the money to the phase

Phase and main risk	Money and gearing
Development: permits fail	Equity only
Construction: delay, overrun	Loans, modest gearing
Operation: demand, costs	Higher gearing, set by DSCR
Refinancing: rates, terms	Cheaper debt frees equity

IN THE LESSON

- Pulling the phases together in one table.
- In development, the money is all equity and the risk is that permits fail.
- In construction, the lenders step in with loans, but the project earns nothing yet, so the amount of gearing, meaning the share funded by debt, should be modest, with the risk of delay and overrun.
- In operation, with proven cash flow, lenders will allow the higher gearing sized by coverage.
- At refinancing, cheaper debt replaces the old and releases equity.
- And at handback, the concession ends and the asset passes to the government.
- The trap runs one way: gearing suited to an operating asset is too high during construction.

21 Mistakes to avoid so far

- Assuming all infrastructure is low risk
- Judging by label, not by revenue model
- Closed end fund for very long lived assets
- Operating gearing during construction
- Expecting refinancing gains before construction ends

IN THE LESSON

- Let us collect the common mistakes from the first three topics.
- One: assuming all infrastructure is low risk, when greenfield and demand based assets behave like equity.
- Two: judging an asset by its label instead of its revenue model, regulated, contracted or demand based.
- Three: choosing a closed end fund for core assets whose lives are far longer than the fund's.
- Four: using the gearing suited to an operating asset during construction, when the cash flow is only a forecast.
- Five: forgetting that refinancing lifts equity returns only after construction risk is behind the project, not before.

22 A story: renting a road with a return date

- A 20-year lease that ends: add up, then stop
- Value depends on facts behind the model
- Investigate before you value
- Trust the traffic forecast only after testing

IN THE LESSON

- Imagine the council offers you a lease on a toll road for twenty years.
- At the end, the road goes back to the council and you get nothing.
- What would you pay today?
- You would not value it like a house you keep for ever.
- You would add up the tolls you expect in each of the twenty years, discount them, and stop.
- Anything beyond year twenty is not yours.
- That is how infrastructure is valued, but first you must investigate, because the value depends on facts you cannot see in a model: who can change the tariff, whether the customers will pay, whether the asset works, and whether the traffic forecast is honest.
- Mira Okafor starts with the checking.

23 What due diligence covers

Due diligence for an infrastructure asset

Area	Key question
Regulation and concession	Tariff rules, length, termination
Counterparties, demand	Credit of payer; independent study
Technical, construction	Sound asset, fixed price contracts
ESG, politics, financing	Hidden liabilities, debt terms

IN THE LESSON

- Here is the checklist, in four groups.
- First, the regulatory regime and the concession terms: how the tariff is set, how long the concession runs, and how it can be terminated.
- Second, counterparties and demand: the credit quality of the offtaker who buys the output or the government that makes availability payments, and independent traffic or usage studies instead of the seller's own numbers.
- Third, technical condition and the construction contracts: is the asset sound, are the builders experienced and the contracts fixed price.
- Fourth, environmental and E S G issues, political risk, and the financing structure itself.
- Each item connects to a risk from earlier in the lesson, and a gap anywhere can change the value.

24 Valuing a concession

Value = $CF_1 \div (r - g) \times [1 - ((1 + g) \div (1 + r))^{n}]$
no terminal value at handback

Next year's cash flow	Cash flow next year
Discount rate	Reflects this asset's risk
Growth with inflation	Inflation linked growth
Years left in concession	Then the road goes back

IN THE LESSON

- Valuation is mainly a discounted cash flow over the life of the concession, or the asset.
- Add up each year's cash flow divided by one plus the discount rate to the power of the year.
- If the cash flow starts at a figure next year and grows with inflation, there is a shortcut: the first cash flow, divided by the discount rate minus the growth rate, times one minus the ratio of one plus growth to one plus the discount rate, all to the power of the years left.
- The key point is what is missing: no terminal value, if the asset must be handed back.
- The discount rate must reflect the regulatory, demand and construction risk of this asset, not the rate used for a different, safer one.

25 Example 5: valuing the toll road

20 years left; CF_1 = 10; g = 2%; r = 8%; road is handed back

Concession value	$10 \div 6\% \times (1 - (1.02 \div 1.08)^{20})$	**113.5**
Cash flow in year 21	10×1.02^{20}	**14.9**
Terminal value at year 20	14.9 ÷ 6%	**247.7**
Its value today	$247.7 \div 1.08^{20}$	**53.1**
Overstated value	113.5 + 53.1 ≈ 166.7	**47% too high**

IN THE LESSON

- Let us value the road.
- A toll concession has twenty years left and then goes back to the council for nothing.
- Cash flow next year is ten, growing with inflation of two per cent, and the discount rate is eight per cent.
- Ten over six per cent is one hundred and sixty six point seven.
- Multiply by one minus, one point zero two over one point zero eight, all to the twentieth power, and the value is one hundred and thirteen point five.
- Now suppose an analyst adds a terminal value, as if the road were kept for ever.
- The year twenty one cash flow is fourteen point nine, capitalised to two hundred and forty seven point seven, and worth fifty three point one today.
- The total is one hundred and sixty six point seven, forty seven per cent too high.

26 Three answers for one road

Value today

Concession only	**113.5**
With terminal value	**166.7**
Traffic 10% lower	**102.2**

Only the first is a sound base case

IN THE LESSON

- Look at how three analysts value the same road.
- The vertical axis is value today, in the same units.
- The first bar is correct, one hundred and thirteen point five, twenty years of cash flow and nothing more.
- The second bar is the analyst who adds a terminal value the owner is not entitled to: one hundred and sixty six point seven.
- That is not a rounding error.
- It is nearly half as much again, for an asset that will belong to the council.
- The third bar shows the correct approach if the seller's traffic forecast proves ten per cent too high, so every cash flow is ten per cent lower: one hundred and two point two.
- Optimism and a false ending are the two most common ways to overpay.

27 Example 6: sensitivities and cross-checks

Base case value 113.5; sensitivities on the toll road

Discount rate 9% instead of 8%	same cash flows	**105.0**
Inflation 1% instead of 2%	g falls to 1%	**105.5**
Volumes 10% lower	0.9 × 113.5	**102.2**
Utility value against asset base	1,200 ÷ 1,000	**1.2 times**

IN THE LESSON

- A single value is never the answer, so Mira Okafor runs sensitivities on the things she cannot know.
- Raise the discount rate from eight to nine per cent and the value falls to one hundred and five.
- Lower inflation from two to one per cent and it falls to one hundred and five point five.
- Cut volumes by ten per cent and it is one hundred and two point two.
- Then she cross checks.
- A regulated utility is also judged against its regulated asset base, the value on which the regulator lets it earn a return.
- If the utility's enterprise value is twelve hundred and its asset base is one thousand, the ratio is one point two.
- Comparable transactions give another benchmark for that ratio.

28 Four strategies, from core to opportunistic

Illustrative target returns, not forecasts

Strategy and what it holds	Target return
Core: regulated, contracted	7%
Core plus: some volume risk	9%
Value added: greenfield, merchant	12%
Opportunistic: emerging, development	15%

IN THE LESSON

- Now to risk and return.
- Investors group infrastructure strategies on a ladder.
- Core is at the bottom: regulated utilities and contracted brownfield assets, with low risk and steady income.
- Core plus adds a little more risk, perhaps some volume exposure or modest improvement plans.
- Value added brings in greenfield construction, merchant or demand exposure, and more gearing.
- Opportunistic goes furthest: new technologies, emerging markets and development risk.
- As you climb the ladder, both the expected return and the dispersion of outcomes rise.
- The figures in the table are only made up illustrations of target returns, to show the shape.

29 Example 7: inflation and rates

Core infrastructure: 5% real, indexed. Bond: 4.5% fixed. Duration 15

Infrastructure, inflation 2%	5% + 2%	**7% nominal**
Infrastructure, inflation 4%	5% + 4%	**9% nominal**
Bond, inflation 2%	4.5% − 2%	**2.5% real**
Bond, inflation 4%	4.5% − 4%	**0.5% real**
Discount rate up one point	15 × 1%	**−15% in value**

IN THE LESSON

- Here is why a pension plan with inflation linked liabilities likes core infrastructure.
- Suppose it earns a real return of five per cent through indexed income.
- When inflation is two per cent, its nominal return is about seven.
- When inflation doubles to four, the nominal return is about nine, and the real return is still five.
- Now compare a fixed rate bond yielding four point five per cent.
- With inflation at two, its real return is two point five.
- At four, it is only point five.
- But there is a catch.
- Infrastructure values are discounted over long lives, so with a duration of fifteen, a one point rise in the discount rate cuts the reported value by about fifteen per cent.
- Long lived income streams react strongly to rates.

30 Real return when inflation rises

Real return (%)

Core, 2% inflation	**5%**
Core, 4% inflation	**5%**
Bond, 2% inflation	**2.5%**
Bond, 4% inflation	**0.5%**

Illustrative figures

IN THE LESSON

- Here is the first part as a picture.
- The vertical axis is the real return, in per cent.
- The first two bars are core infrastructure, at inflation of two per cent and four per cent.
- Both stand at five, because its income is indexed.
- The last two bars are the fixed rate bond.
- At two per cent inflation its real return is two point five.
- At four per cent, it falls to just point five.
- So inflation doubling leaves the infrastructure untouched in real terms and nearly wipes out the bond.
- That is the diversification benefit and the inflation hedge, and it is the main reason pension plans and insurers with inflation linked liabilities use core infrastructure as a source of income.

31 Infrastructure beside the other assets

Where core infrastructure sits

Against	Difference
Bonds	Longer, inflation linked income; more risk
Real estate	Similar income; longer lives, more regulation
Private equity	Lower return, lower volatility
Listed equity	Short run moves with markets

IN THE LESSON

- Finally, where does it fit in a strategic allocation?
- Against bonds, core infrastructure offers long duration, often inflation linked income, with more risk.
- Against real estate, it plays a similar income role, but its assets last longer and its regulatory risk is higher.
- Against private equity, its expected return is lower and so is its volatility.
- So it suits long horizon investors with inflation linked liabilities, such as pension plans and insurers, as income and diversification.
- Now the trap.
- Listed infrastructure moves with equity markets in the short run, and even unlisted valuations stay sensitive to changes in discount rates, so smooth reported values are not the same as low risk.

32 Recap: the lesson in five lines

- Essential, long lived, but risk varies by asset
- Route: size, liquidity, governance, fees
- Equity, then loans, then refinancing; size by DSCR
- Value: discounted cash flow, no false ending
- Core is lower risk; other strategies rise

IN THE LESSON

- Let us pull the lesson together.
- First, infrastructure provides essential services, with long lived assets, high barriers to entry and often inflation linked cash flows, but risk depends on the revenue model and the stage.
- Second, routes in range from direct deals to funds, co investments, listed shares, partnerships and debt, chosen by size, liquidity, governance and fees.
- Third, a project is funded by equity first, then loans, then cheaper refinancing, with debt sized by the coverage ratio.
- Fourth, value is a discounted cash flow with no terminal value at handback, tested by diligence and sensitivities.
- Fifth, core sits at the safe end, and risk and return rise with each strategy.

33 Try three quick questions

1. CFADS 36, required DSCR 1.5. Maximum debt service?
   Answer: 36 ÷ 1.5 = 24 a year.
2. Terminal value 100 at year 10 on a concession that ends. Overstatement at 8%?
   Answer: 100 ÷ 1.08^{10} = 46.3, which should not be there.
3. Fixed bond yields 4.5%; inflation rises to 4%. Real return?
   Answer: 4.5% − 4% = 0.5%.

IN THE LESSON

- Now try three quick questions yourself.
- Pause after each one.
- Question one.
- A project expects cash flow available for debt service of thirty six a year, and lenders require coverage of one point five.
- What is the most debt service it can bear?
- Thirty six divided by one point five is twenty four a year.
- Question two.
- A concession ends in ten years with nothing handed back, yet an analyst adds a terminal value of one hundred at year ten, discounted at eight per cent.
- How much has the value been overstated?
- One hundred divided by one point zero eight to the tenth is forty six point three.
- Question three.
- A bond yields four point five per cent fixed, and inflation rises to four per cent.
- What is its real return?
- Point five per cent, so inflation has eaten almost all of it.