Growth theories, convergence, demographics and trade

Economics

1 Resources: blessing or curse?

- Renewable: forests, fisheries. Non-renewable: oil, minerals
- Resources can support growth
- Few resources, fast growth: trade, capital, technology
- Access matters more than ownership
- Abundance can even hold growth back

IN THE LESSON

- Elena's first question is about natural resources.
- Picture two villages.
- One sits beside a rich fishery.
- The other has no fish at all, only a good harbour.
- Which grows faster?
- Many people guess the first.
- But history is mixed.
- Natural resources come in two kinds.
- Renewable ones, like forests and fisheries, regrow if they are managed well.
- Non renewable ones, like oil and minerals, are gone once taken.
- They can certainly support growth.
- Yet some economies with almost no resources have grown fast through trade, capital and technology.
- What matters is access, meaning whether you can buy, sell and use resources, more than who owns them under the ground.
- And resource wealth can even hold growth back, as the next picture shows.

2 Dutch disease and the resource curse

Dutch disease

Resource boom → Real exchange rate rises → Traded sectors squeezed → Productivity gains lost

Rents and institutions

Easy resource money → Less pressure for good rules → Weaker institutions → Slower growth

IN THE LESSON

- It has an odd name, Dutch disease, but the chain is simple, and nobody in it makes a mistake.
- Follow the top row from the left.
- First, a resource boom: foreign buyers pay a lot for the resource.
- Second, the real exchange rate rises.
- Buyers need the local currency to pay, which pushes it up, and spending the windfall pushes local wages and prices up too.
- Third, manufacturing and other traded sectors are squeezed, because their costs rise at home while their prices are set in world markets.
- Fourth, the productivity gains those sectors generate are lost.
- Now the bottom row.
- Resource rents can also weaken institutions, because easy money for the state removes the pressure to build good rules.
- Both chains point to slower growth.

3 Example 1: a squeezed exporter

Exporter: USD 80 a unit, rate 6.00 falls to 5.25

Revenue before	80 × 6.00	**480**
Cost before	profit of 60	**420**
Revenue after	80 × 5.25	**420**
Cost after	420 × 1.05	**441**
Result per unit	420 − 441	**−21**

IN THE LESSON

- Let's put numbers on the squeeze.
- Take a factory in a resource economy we will call Dunmere.
- It sells its goods abroad for eighty dollars a unit.
- The exchange rate is six local currency units to the dollar, so each unit brings in four hundred eighty.
- Local costs are four hundred twenty, a profit of sixty, which is twelve and a half per cent of revenue.
- Now a mining boom lifts the local currency, and the rate falls to five point two five.
- The same eighty dollars buys only four hundred twenty.
- At the same time wages and prices chase the boom, and costs rise five per cent to four hundred forty one.
- Revenue four hundred twenty minus costs four hundred forty one is a loss of twenty one, five per cent of revenue.
- The factory did nothing wrong.
- The boom priced it out.

4 Example 2: does scarcity cap growth?

Made-up metal Z: scarcity raises the price

Price before	cheap	**50**
Recycling cost	per unit	**80**
Price after	scarcity bites	**100**
Recycling margin now	100 − 80	**20**
Substitute cost	beats 100	**70**

IN THE LESSON

- The second half of this outcome is a claim you will meet: finite resources must eventually cap growth, because we will run out.
- The reply is prices.
- As a resource gets scarcer, its price climbs, and a rising price does three jobs.
- It drives conservation, because users waste less.
- It drives substitution, because other materials become cheaper by comparison.
- And it drives new technology, because recycling and new sources start to pay.
- Take a made up metal, Z.
- Its price is fifty and recycling it costs eighty, so nobody recycles.
- Scarcity doubles the price to one hundred.
- Now recycling earns a margin of twenty, and a substitute material costing seventy beats the metal too.
- So scarcity is not a fixed ceiling.
- The trap runs both ways: abundance is not strong growth, and scarcity is not a fixed limit.

5 People: how labour input grows

- Labour input: population, participation, immigration, hours
- Young, growing population: demographic dividend
- Ageing: working-age share shrinks, growth slows
- Immigration adds prime-age workers
- More workers lift GDP, not always GDP per person

IN THE LESSON

- Now Elena turns to people.
- Think of a bakery.
- Its output depends on how many bakers there are, how many of them turn up to work, and how many hours they put in.
- An economy is the same.
- Labour input grows with population, with the share of people who take part, with net immigration and with average hours.
- A young, growing population delivers a demographic dividend.
- As children grow up, the working age share rises, and output per person can climb even if nothing else improves.
- Ageing reverses it: the working age share shrinks and growth slows, unless participation or productivity rises.
- Immigration can offset low fertility, because migrants tend to arrive in their prime working years.
- And more workers raise total G D P, but not necessarily G D P per person.

6 The dividend, and its reversal

Chart: Working-age share vs Decades

- Young, growing: dividend
- Ageing: reversal

IN THE LESSON

- Here is that idea drawn.
- Time in decades runs along the bottom, and the share of people of working age goes up the side.
- Start with the green line.
- It begins low, because many people are children who are not yet workers, and it climbs as they grow up.
- That climb is the dividend: more earners relative to everyone else.
- The red line shows an ageing economy.
- It starts high and falls as the large group retires.
- The labour force then grows more slowly than the population, which drags on income per person.
- Immigration is one of the few levers that acts on the falling line directly.
- Both lines are illustrations.
- Real paths vary, but the direction is the lesson.

7 Labour force growth, then potential growth

Labour force growth = (1 + working-age growth) × (new rate ÷ old rate) − 1

Working-age population growth	Growth in people of working age
New participation rate	Share taking part, this year
Old participation rate	Share taking part, last year

IN THE LESSON

- Now the formula.
- It combines population and participation, and the participation rate enters as a ratio.
- Labour force growth equals one plus the growth of the working age population, times the new participation rate divided by the old participation rate, minus one.
- Why a ratio?
- The labour force is the working age population times the participation rate, so when both change, their growth factors multiply.
- A rise from sixty to sixty one per cent is not one per cent growth.
- It is sixty one over sixty, about one point seven per cent.
- Then add productivity.
- Potential G D P growth equals one plus labour force growth, times one plus labour productivity growth, minus one.
- We use both in the example next.

8 Example 3: a one-off rise in participation

Working-age population +0.6%, productivity +1.2%, participation 60% to 61%

Labour force growth, year one	1.006 × (61 ÷ 60) − 1	**2.28%**
Potential GDP growth, year one	1.02277 × 1.012 − 1	**3.50%**
Labour force growth, year two	1.006 × (61 ÷ 61) − 1	**0.60%**
Potential GDP growth, year two	1.006 × 1.012 − 1	**1.81%**

IN THE LESSON

- Elena forecasts for Brenmoor.
- The working age population grows zero point six per cent a year, and labour productivity grows one point two per cent.
- This year participation rises from sixty to sixty one per cent.
- Next year it stays at sixty one.
- Year one: one point zero zero six times sixty one over sixty, minus one, is two point two eight per cent labour force growth.
- Potential G D P growth is that combined with productivity, three point five zero per cent.
- Year two: the ratio is sixty one over sixty one, which is one, so labour force growth is just zero point six per cent, and potential growth falls back to one point eight one.
- The trap: projecting three and a half per cent forward would overstate growth for ever.
- Participation has a ceiling, so its boost is temporary.

9 Capital, skills and technology

- Physical capital: deepening, but diminishing returns
- ICT and infrastructure spill over to everyone
- Human capital: education, training, health
- R&D pushes the frontier; poorer economies adopt
- Not all investment is equally productive

IN THE LESSON

- Now what Brenmoor spends its money on.
- Picture a farm.
- Give each farmhand a first spade and output jumps.
- Give each a tenth spade and it barely moves.
- That is capital deepening with diminishing returns: more capital per worker raises output per worker, but each extra step adds less.
- Some capital behaves differently.
- Information and communication technology, and public infrastructure such as roads and ports, spill over: they make everyone else in the economy more productive too.
- Human capital means the skills and knowledge people gain from education, training and health.
- It makes workers more productive and helps the economy take up new technology.
- Research and development pushes the frontier out in rich economies.
- Poorer economies gain most by adopting what already exists.

10 More capital, smaller gains

Chart: Output per worker vs Capital per worker

- Better technology
- Today's technology
- Early capital: big gain
- Late capital: small gain

IN THE LESSON

- Here is the picture.
- Capital per worker runs along the bottom, output per worker up the side.
- Follow the lower curve from the left.
- It rises steeply at first: a worker with almost no tools gains a lot from the first ones.
- Further right the curve flattens, so the same extra step of capital barely lifts output.
- That flattening is diminishing returns.
- Now the upper curve.
- It sits higher at every level of capital.
- That is what better technology, a more skilled workforce, or capital with spillovers does: it lifts the whole curve instead of sliding along it.
- The first kind of gain fades.
- The second kind can carry on.
- So when you judge an investment programme, ask which of the two movements it buys.

11 Growth in output per worker

Output per worker growth = TFP growth + α × capital per worker growth

Output per worker growth	What we want to explain
TFP growth	Technology, skills, organisation
α: capital's share of income	Weight on capital deepening
Capital per worker growth	Capital deepening

IN THE LESSON

- A Level One reminder: output depends on technology, capital and labour.
- Dividing by labour, growth in output per worker equals growth in total factor productivity, written T F P, plus capital's share of income times growth in capital per worker.
- T F P is everything that raises output beyond simply adding inputs: better technology, skills and organisation.
- Capital's share, the Greek letter alpha, is zero point four in our examples.
- Read the formula as a budget.
- Each one point of capital deepening buys only alpha of a point of growth.
- A point of T F P buys a whole point.
- That is why technology and skills matter so much, and why investment alone disappoints when it goes into low return projects.

12 Example 4: two ways to grow the same

α = 0.4. A: capital +5%, TFP 0.4%. B: capital +2.5%, TFP 1.4%

A: output per worker growth	0.4% + 0.4 × 5%	**2.4%**
B: output per worker growth	1.4% + 0.4 × 2.5%	**2.4%**
A: share from capital	0.4 × 5% ÷ 2.4%	**83%**
B: share from capital	0.4 × 2.5% ÷ 2.4%	**42%**

IN THE LESSON

- Two economies, capital share zero point four.
- Economy A saves and invests heavily: capital per worker grows five per cent a year, and T F P grows zero point four per cent.
- Economy B invests half as much, two and a half per cent, but its skilled workforce adopts new technology, so T F P grows one point four.
- For A: zero point four plus zero point four times five is two point four per cent.
- For B: one point four plus zero point four times two and a half is also two point four per cent.
- Capital deepening supplies eighty three per cent of A's growth, but only forty two per cent of B's.
- A invests twice as hard to grow no faster, and its edge will fade.
- The trap: a high investment rate in low return projects, or equipment nobody is trained to use, adds little.

13 Three theories of growth

- Classical: extra income breeds people, back to subsistence
- Neoclassical: diminishing returns, steady state
- Neoclassical growth comes from outside technology
- Endogenous: spillovers offset diminishing returns

IN THE LESSON

- Now the theories.
- The classical idea is old, so start with a village.
- When harvests are good, families grow larger.
- Soon there are more mouths to feed, and income per person falls back to bare subsistence.
- That is classical growth theory, after Malthus: any income above subsistence triggers population growth that pushes it back, so living standards cannot rise for good.
- Neoclassical theory, after Solow, adds diminishing returns to capital.
- The economy settles into a steady state, where output per worker grows only as fast as outside, or exogenous, technological progress.
- Endogenous theory explains technology inside the model.
- Knowledge spillovers offset diminishing returns, so investment can raise growth for good.
- The test that separates them is simple: what does a higher saving rate do?

14 What a higher saving rate does

Effect of a permanent rise in the saving rate

Theory	Saving rise gives
Classical	Nothing lasting
Neoclassical	A higher level
Endogenous	Faster growth

IN THE LESSON

- Let's use that question to tell the three apart.
- Suppose Brenmoor's government pushes the saving rate up.
- Under classical theory, nothing lasts.
- Any extra income is eaten by population growth.
- Under neoclassical theory, the economy ends up with a higher level of output per worker, after a temporary burst of faster growth, but the steady state growth rate is unchanged.
- Under endogenous theory, growth itself can be permanently faster.
- This is the table to memorise.
- Exam questions disguise it with a story: someone argues that more saving will lift long run growth for good.
- That argument is endogenous.
- Do not credit the neoclassical model with it, because in that model saving moves the level of the path and not its slope.

15 The neoclassical steady state

Output per worker growth = TFP growth ÷ (1 − α)
Total output growth = that + labour force growth

Output per worker growth	Steady-state growth per worker
TFP growth	Outside technological progress
α: capital's share of income	Capital's share of income
Labour force growth	Adds to total output only

IN THE LESSON

- Now the steady state formulas for the neoclassical model.
- In steady state, output per worker grows at total factor productivity growth divided by one minus alpha.
- Why the division?
- Faster T F P raises output directly.
- It also raises the return on capital, which draws in more capital per worker, so the full effect is bigger than T F P alone.
- Alpha is capital's share, so one minus alpha is labour's share.
- The bigger alpha is, the bigger the multiplier.
- Total output grows at that rate plus the growth of the labour force.
- Look at what is missing from both formulas: the saving rate.
- It is not there.
- That absence is the neoclassical point.

16 Example 5: raise the saving rate

TFP growth 1.5%, α = 0.25, labour force growth 0.5%

Output per worker, steady state	1.5% ÷ (1 − 0.25)	**2.0%**
Total output, steady state	2.0% + 0.5%	**2.5%**
Saving rises 20% to 30%	neoclassical	**still 2.0%**
Same rise, endogenous view	spillovers	**can go up**

IN THE LESSON

- Elena applies this to a neoclassical economy where T F P grows one point five per cent, alpha is zero point two five, and the labour force grows zero point five per cent.
- Output per worker grows one point five divided by one minus zero point two five, which is zero point seven five, so two per cent.
- Total output grows two plus zero point five, two and a half per cent.
- Now the saving rate rises from twenty to thirty per cent.
- The neoclassical answer is still two per cent in steady state, after a temporary spurt, with output per worker settling on a higher level.
- Under an endogenous model, the growth rate can rise for good.
- As a check on the formula, if alpha were one half, the answer would be three per cent, since a higher alpha magnifies T F P.

17 Level effect or growth effect

Chart: Log output vs Time

- Endogenous: faster for good
- Neoclassical: higher level
- No change
- Saving rises

IN THE LESSON

- Here is the same story as a picture.
- Time runs along the bottom, and the side shows the log of output per worker.
- On a log scale a straight line means a steady growth rate, so compare slopes, not heights.
- All paths share one history until the saving rate rises.
- The grey line carries on unchanged.
- The neoclassical line climbs faster for a while as extra capital builds up, then diminishing returns pull its slope back to the old one.
- It ends higher but parallel to the grey line.
- That is a level effect.
- The endogenous line never bends back, because spillovers keep returns from falling, so it ends up steeper.
- Classical theory would not even allow the rise.

18 Mistakes to avoid so far

- Abundant resources do not guarantee growth
- A one-off rise in participation is not a lasting boost
- More capital alone fades; skills and technology do not
- Neoclassical: saving lifts the level, not steady-state growth
- Steady state: do not skip the 1 − α divisor

IN THE LESSON

- Before the next idea, four mistakes that lose marks.
- One.
- Treating resource abundance as strong growth, or scarcity as a fixed ceiling.
- Dutch disease and prices say otherwise.
- Two.
- Rolling a one off rise in participation forward as if it were a trend.
- The ratio returns to one once the rate settles.
- Three.
- Assuming all investment is equally productive.
- More capital alone meets diminishing returns, while skills and technology do not.
- Four.
- Crediting the neoclassical model with permanently higher growth from more saving.
- That is endogenous growth.
- And remember the divisor in the steady state formula is one minus alpha.
- Skipping it gives the T F P figure alone, a favourite wrong answer option.

19 Will the poor catch up?

- Absolute: all poor economies catch up
- Conditional: only with matching saving and tech
- Club: only inside a club with the right institutions
- Outside the club: a possible non-convergence trap
- Evidence favours conditional and club; openness helps

IN THE LESSON

- Now Elena's real question: will poor Brenmoor and Corrada catch up with Altavia?
- Picture a school race where some runners start far behind.
- Convergence asks whether poorer economies close the gap in output per person.
- There are three versions.
- Absolute convergence says they all do, whatever their characteristics, because capital is scarce there, so returns to capital are higher and attract investment.
- Conditional convergence says catch up happens only among economies with the same saving rate, population growth and production function, because each heads for its own steady state.
- Club convergence says only economies that join a club with the right institutions and policies converge.
- Those outside may fall into a non convergence trap.
- Openness to trade and capital flows speeds catch up.

20 Catching up, or not

Chart: Output per person vs Decades

- Altavia: rich
- Brenmoor: in the club
- Corrada: outside

IN THE LESSON

- Here is club convergence as a picture.
- Time in decades runs along the bottom, and output per person goes up the side.
- The top line is Altavia, rich and growing slowly.
- The middle line is Brenmoor, which starts poor but sits inside the club, with sound institutions, saving and openness.
- It climbs faster, so the gap closes.
- The bottom line is Corrada.
- It starts at the very same point as Brenmoor, which is the test that absolute convergence fails.
- If being poor were enough, the two poor lines would be one line.
- Corrada has a low steady state of its own, so there is little to converge to, and it barely moves.
- The evidence favours the conditional and club versions.

21 How long does catching up take?

Years = ln(rich ÷ poor income) ÷ ln[(1 + poor growth) ÷ (1 + rich growth)]

Years to catch up	Time until the gap closes
Rich income ÷ poor income	How far behind the poor are
Poor economy's growth	Must beat the rich economy
Rich economy's growth	The growth to beat

IN THE LESSON

- How long does catch up take?
- A Level One reminder: growth compounds, so income grows by one plus the growth rate each year.
- Poor income times its growth factor to the power t equals rich income times its growth factor to the power t.
- Solving for t gives the formula.
- Years to catch up equals the natural logarithm of the rich income divided by the poor income, all divided by the natural logarithm of one plus the poor economy's growth over one plus the rich economy's growth.
- It works only if the poor economy grows faster.
- Otherwise the answer is negative and there is no catch up.
- The answer is usually long, measured in generations.

22 Example 6: Brenmoor against Corrada

Altavia $50,000 at 2%; Brenmoor and Corrada start at $5,000

Years for Brenmoor to catch up	ln(10) ÷ ln(1.05 ÷ 1.02)	**79.4**
Brenmoor after 80 years	5,000 × 1.05^80	**$247,807**
Altavia after 80 years	50,000 × 1.02^80	**$243,772**
Corrada after 80 years	5,000 × 1.01^80	**$11,084**
Corrada as share of Altavia	11,084 ÷ 243,772	**4.5%**

IN THE LESSON

- Altavia's income per person is fifty thousand dollars, growing two per cent a year.
- Brenmoor and Corrada each start at five thousand.
- Brenmoor grows five per cent.
- Corrada, with weak institutions and a low saving rate, grows one per cent.
- Years for Brenmoor to catch up: the natural logarithm of ten, divided by the natural logarithm of one point oh five over one point oh two.
- That is seventy nine point four years.
- After eighty years Brenmoor is at about two hundred forty eight thousand, just past Altavia at about two hundred forty four thousand.
- Corrada after eighty years is at about eleven thousand, only four and a half per cent of Altavia's income, down from ten per cent at the start.
- Corrada is exactly as poor as Brenmoor was, yet it falls further behind.
- The trap is expecting every poor economy to converge.

23 Why governments back private research

- Knowledge is partly a public good: copied cheaply, shared
- The firm keeps only part of the return; the rest spills over
- Private return below hurdle, social above: underinvestment
- Remedies: R&D credits, basic research, patents, education
- The case rests on spillovers, not the firm's own profit

IN THE LESSON

- A new question.
- Why should a government help private firms do research?
- Imagine a baker who invents a better recipe.
- Once it has been tasted, rivals can copy it.
- The baker paid for the invention and shares the benefit.
- Knowledge is partly a public good: once created it can be copied cheaply, and one person's use does not stop another's.
- A firm investing in research captures only part of the return.
- The rest spills to rivals who copy, suppliers who learn and customers who pay less than the value they receive.
- So the social return exceeds the private return.
- A firm rejects a project when its private return falls below its cost of capital, even if the social return clears it, and the economy underinvests.
- That gap justifies subsidies, tax credits, funding for basic research, patents and education.
- In endogenous models such policies can raise long run growth.

24 Who gets the return on research

Annual return (%)

Firm's return	**7%**
Firm's hurdle	**9%**
Social return	**16%**

The firm says no; society should say yes

IN THE LESSON

- Here are the three returns as bars.
- The first bar is what the firm keeps from a research project: seven per cent a year.
- The second is the firm's hurdle, the cost of capital it needs to earn: nine per cent.
- Seven is below nine, so the firm turns the project down.
- The third bar is the social return, the benefit to everyone the knowledge reaches: sixteen per cent.
- That is well above the hurdle.
- The gap between the first and third bars is the spillover, nine points in all, flowing to rivals, suppliers and customers who do not pay the firm.
- The tall bar, not the short one, is why the government should care.
- If the case had rested on the firm's own seven per cent, there would be no case at all.

25 Example 7: a tax credit closes the gap

Cost 200, firm earns 14 a year, hurdle 9%, social return 16%

Private return	14 ÷ 200	**7.0%**
Net cost after 30% credit	200 × (1 − 0.30)	**140**
Private return after credit	14 ÷ 140	**10.0%**
Largest cost firm would accept	14 ÷ 0.09	**155.56**
Smallest credit that works	1 − 155.56 ÷ 200	**22.2%**

IN THE LESSON

- Let's test a tax credit.
- A project costs two hundred and yields the firm fourteen a year for ever.
- The firm's hurdle is nine per cent.
- The private return is fourteen over two hundred, seven per cent, so it is rejected.
- Now the government offers a thirty per cent R and D tax credit.
- The net cost is two hundred times one minus zero point three, which is one hundred forty.
- The private return becomes fourteen over one hundred forty, ten per cent, which clears nine.
- Accepted.
- How big must the credit be?
- The firm accepts any cost up to fourteen divided by zero point zero nine, about one hundred fifty five point five six.
- So a credit of at least twenty two point two per cent is enough.
- The credit does not improve the project.
- It lets the firm keep enough of the return to do what the economy already wanted done.

26 Dropping the barriers

- Gains: specialisation, scale, cheaper inputs
- Capital flows to where it earns more: the poorer economy
- Poorer economy: more capital, higher wages, faster growth
- Richer economy: investors earn more, consumers pay less
- But every economy has losers where protection ends

IN THE LESSON

- Last idea: trade.
- Picture two towns on a river.
- One bakes bread well, the other makes cloth well.
- If both stay closed, each makes everything badly.
- If they open up, each specialises in what it does best, and both end up better off.
- Dropping trade barriers raises growth through specialisation by comparative advantage, bigger markets with economies of scale, cheaper inputs, the spread of technology, and competition that forces firms to be efficient.
- If capital can also flow freely, it moves from capital rich economies to capital poor ones, where returns are higher.
- That raises investment, wages and growth in the poorer economy and speeds convergence, while investors from the richer economy earn more.
- But the gains are uneven, and every economy has losers.

27 Where capital earns more

Return on capital (%)

Rich, before	**4%**
Poor, before	**10%**
Rich, after	**7%**
Poor, after	**7%**

Capital moves until returns meet

IN THE LESSON

- Here is the capital story as bars, with returns in per cent a year up the side.
- Before opening, capital is plentiful in the rich economy, so an extra unit earns only four per cent.
- In the poor economy it is scarce and earns ten.
- Now barriers come down.
- Capital flows from where it earns four to where it earns ten, and the returns move together, here to about seven per cent in both.
- Notice who gains.
- Investors in the rich economy now earn seven instead of four on money placed abroad.
- The poor economy gets more capital per worker, so its wages and growth rise and it converges faster.
- Notice also the poor economy's own owners of capital: their return falls from ten to seven.
- That is the first sign that gains are uneven.

28 Example 8: one winner, one loser

Investor moves $200m abroad; mill's price falls 120 to 100

Income at home	$200m × 4%	**$8m**
Income abroad	$200m × 7%	**$14m**
Gain for the investor	14 − 8	**$6m**
Mill margin, with tariff	120 − 108	**+12 a unit**
Mill margin, no tariff	100 − 108	**−8 a unit**

IN THE LESSON

- Now two sides of one opening.
- Elena's investor moves two hundred million dollars from the rich economy to new plants in the poor one.
- At home it earned four per cent, eight million.
- Abroad it earns seven per cent, fourteen million.
- A gain of six million.
- The poor economy gets the capital, jobs and higher wages.
- But look at a textile mill there that was protected by a tariff.
- Under the tariff its price was one hundred twenty and its cost is one hundred eight, a margin of twelve a unit.
- When the tariff goes, imports set the price at one hundred.
- The margin is minus eight.
- The mill loses money and jobs go, and while resources shift to competitive sectors the adjustment costs can be large in the short run.

29 Who gains and who loses

Opening up to trade and capital flows

Group	Effect
Rich-economy investors	Gain
Poor-economy workers	Gain
Consumers in both	Gain
Protected industries	Lose

IN THE LESSON

- Let's sum up who gains and who loses.
- Investors from the rich economy gain, because returns abroad are higher.
- Workers in the poor economy gain, because more capital per worker lifts wages.
- Consumers in both economies gain, from cheaper goods.
- But the owners and workers of industries that lose protection lose, like the textile mill in the poor economy.
- And in the rich economy the same happens to import competing industries.
- So the right answer is not that everybody gains, and not that the losses outweigh the gains.
- Overall output and welfare rise because the gains exceed the losses, but the losers are real and easy to identify.
- The exam trap is the word everybody.

30 Recap

- Resources: access, Dutch disease, prices answer scarcity
- Labour: participation boost is one-off; ageing slows growth
- Capital fades; skills, spillovers and technology last
- Three growth theories; three convergence views
- Spillovers justify support; trade lifts welfare, creates losers

IN THE LESSON

- Let's pull it together.
- Natural resources help only if access is good and the windfall is managed: Dutch disease squeezes traded sectors, while rising prices answer the claim that scarcity caps growth.
- Labour input grows with population, participation, immigration and hours, and a one off rise in participation is temporary.
- Capital deepening fades under diminishing returns, while skills, spillovers and technology can last.
- Classical, neoclassical and endogenous theories differ on what saving does: nothing, a higher level, or faster growth.
- Convergence comes in absolute, conditional and club versions, and the evidence favours the last two.
- Research needs support because spillovers make social returns exceed private ones.
- And opening up to trade raises welfare, with real losers.

31 Try three quick questions

1. Working-age population +1.0%; participation 50% to 51%. Labour force growth?
   Answer: 1.01 × (51 ÷ 50) − 1 = 3.02%
2. Neoclassical: TFP growth 1.8%, α = 0.4. Steady-state output per worker growth?
   Answer: 1.8% ÷ 0.6 = 3.0%
3. Firm earns 6% on research, hurdle 8%, social return 15%. Support justified?
   Answer: Yes: the 15% social return is the case, not the 6%.

IN THE LESSON

- Now try three quick questions yourself.
- Pause after each one.
- Question one.
- The working age population grows one per cent, and participation rises from fifty to fifty one per cent.
- What is labour force growth?
- One point oh one times fifty one over fifty, minus one, is three point oh two per cent.
- Question two.
- A neoclassical economy has T F P growth of one point eight per cent and alpha of zero point four.
- What is steady state growth in output per worker?
- One point eight divided by zero point six is three per cent.
- Question three.
- A project earns the firm six per cent against an eight per cent hurdle, but its social return is fifteen per cent.
- Is support justified?
- Yes.
- The fifteen per cent social return, not the six, is the case.
- Well done.