

A short history of 11,000 years of infrastructure finance

Hugh Goldsmith, EIB

*Die wachsende Bedeutung der
Projektfinanzierung im wirtschaftlichen
Umbruch unserer Zeit – EBS*

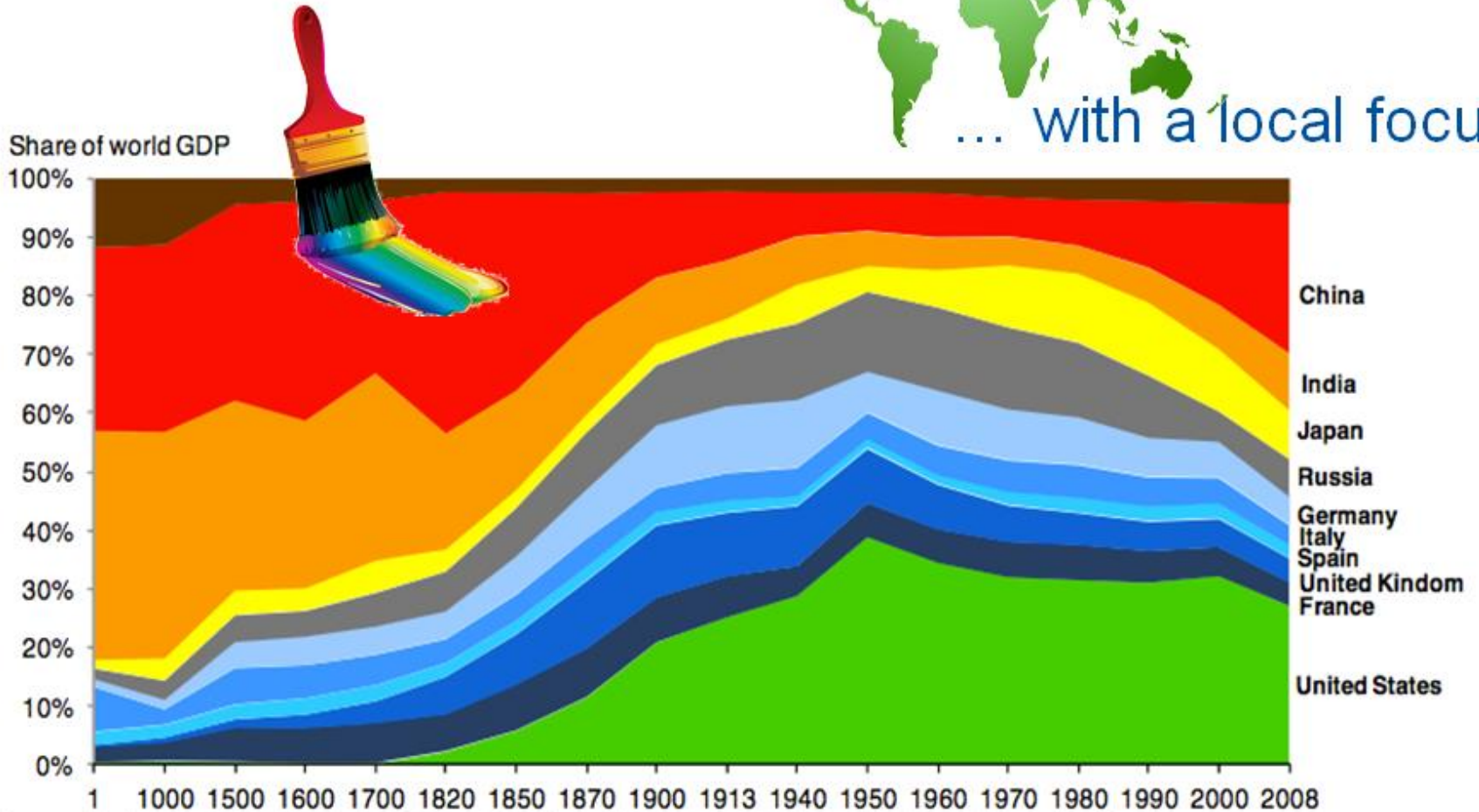
11.12.2020

Big Picture

Global long term picture ...



... with a local focus



EIBURS 2011-2013

A History of European Infrastructure Finance

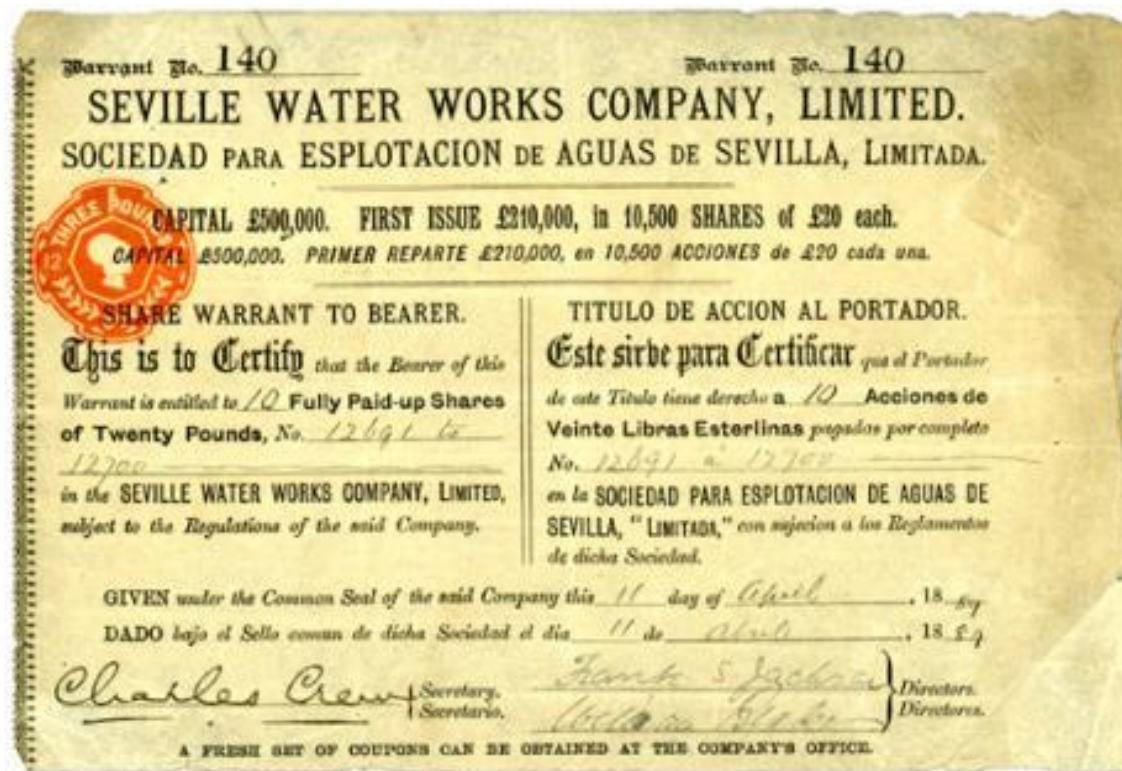


Goldsmith, H., & Carter, D. (2016). The finance of local public goods at the onset of industrialization: Water in London 1582 to 1904. In *Infrastructure finance in Europe: insights into the history of water, transport, and telecommunications*. Oxford University Press, 150-190.

Goldsmith, H. (2015). Actors and innovations in the evolution of infrastructure services in *Picot, A., Florio, M., Grove, N., & Kranz, J. The Economics of Infrastructure Provisioning: The Changing Role of the State*. The MIT Press., 23-94.

Water supply to Seville

In 1882, Seville granted a 99 year Concession to the Seville Water Works Company Ltd (*la Compañía de los Ingleses*). Floated on London Stock Exchange in 1883. Concession given up in 1957.

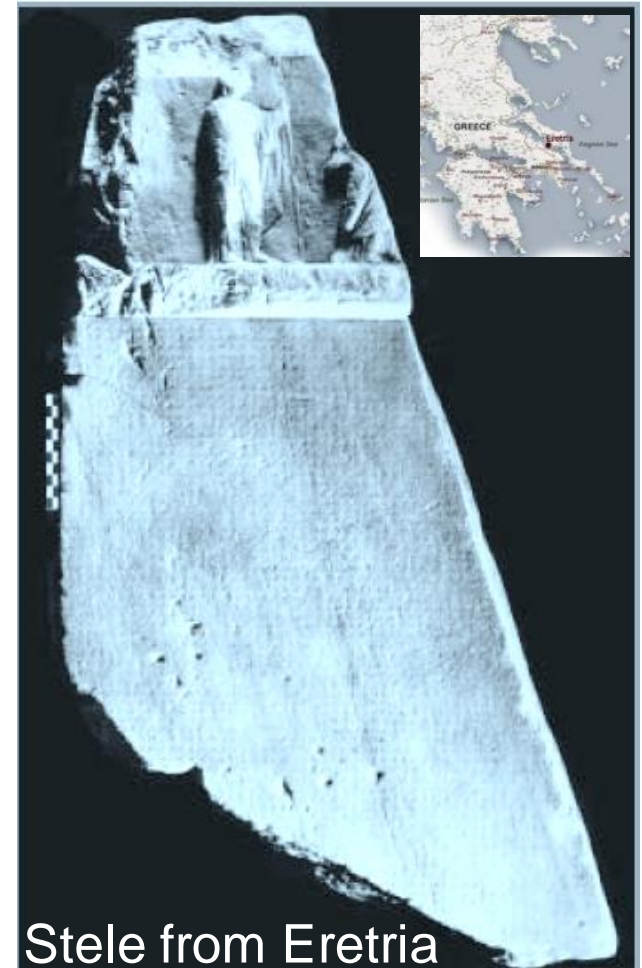


I became a
"scripophilist"

The First PPP Contract - Eretria (~318BC)

Contract between City *and* foreign contractor Chairephanes to drain lake Ptekhæ:

- *all expenses paid by the contractor plus lump sum of 30 talents paid to the City*
- *contractor granted exclusive right to cultivate and retain the products of the reclaimed land for 10 years*
- *exemption of local taxes and some laws*
- *4 year schedule, extended in case of war*
- *obligation on Chairephanēs heirs/collaborators to complete works in case of death*
- *contract was "signed" by 230 citizens with six named Eretria-citizens as guarantors*
- *extreme sanctions against anyone attempting to cancel the contract (copy in Delphi)*



What is Infrastructure?

Dictionary Definition

- 1: the underlying foundation or basic framework (as of a system or organization)
- 2: the permanent installations required for military purposes
- 3: the system of **public works** of a country, state, region or city

First use in 1927 (OED)

No commonly accepted definition
... and its very political



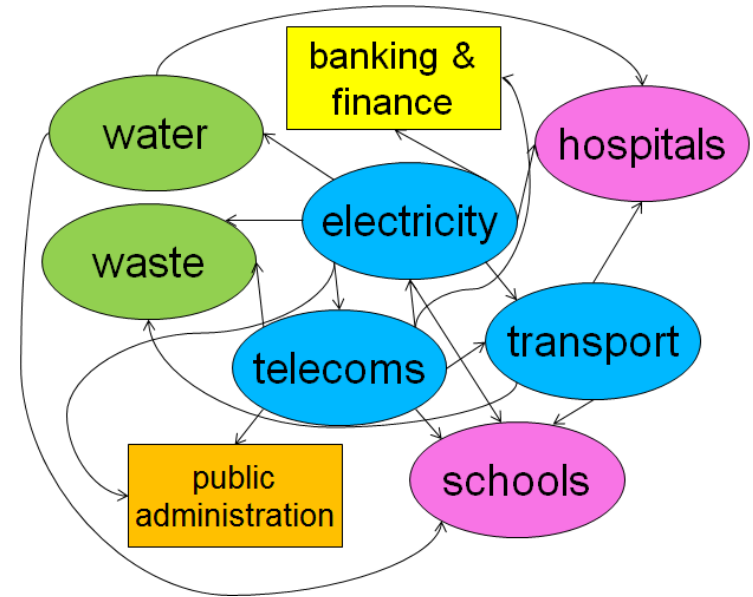
“Crumbling infrastructure will be replaced with new roads, bridges, tunnels, airports, and railways gleaming across our very, very beautiful land”

Modern Infrastructure

WATER / HYDRAULIC	•Irrigation canals; Water supply; Dams; Drainage; Flood defence
TRANSPORT	•Roads; Bridges; Ports; Canals; Railways; Tramways; Airports
ENERGY	•Gas; Electricity; Oil; Nuclear; Renewables
TELECOMS	•Telegraph; Telephone; Wireless; TV; Internet; Broadband
SOCIAL	• Universities; Schools; Hospitals; Prisons; social housing; Justice facilities
URBAN	• Public buildings; streets; sports facilities; parks
ENVIRONMENTAL	•Wastewater treatment; Waste disposal; green infrastructure

ECONOMIC
SOCIAL

Economic - Social - Environmental objectives



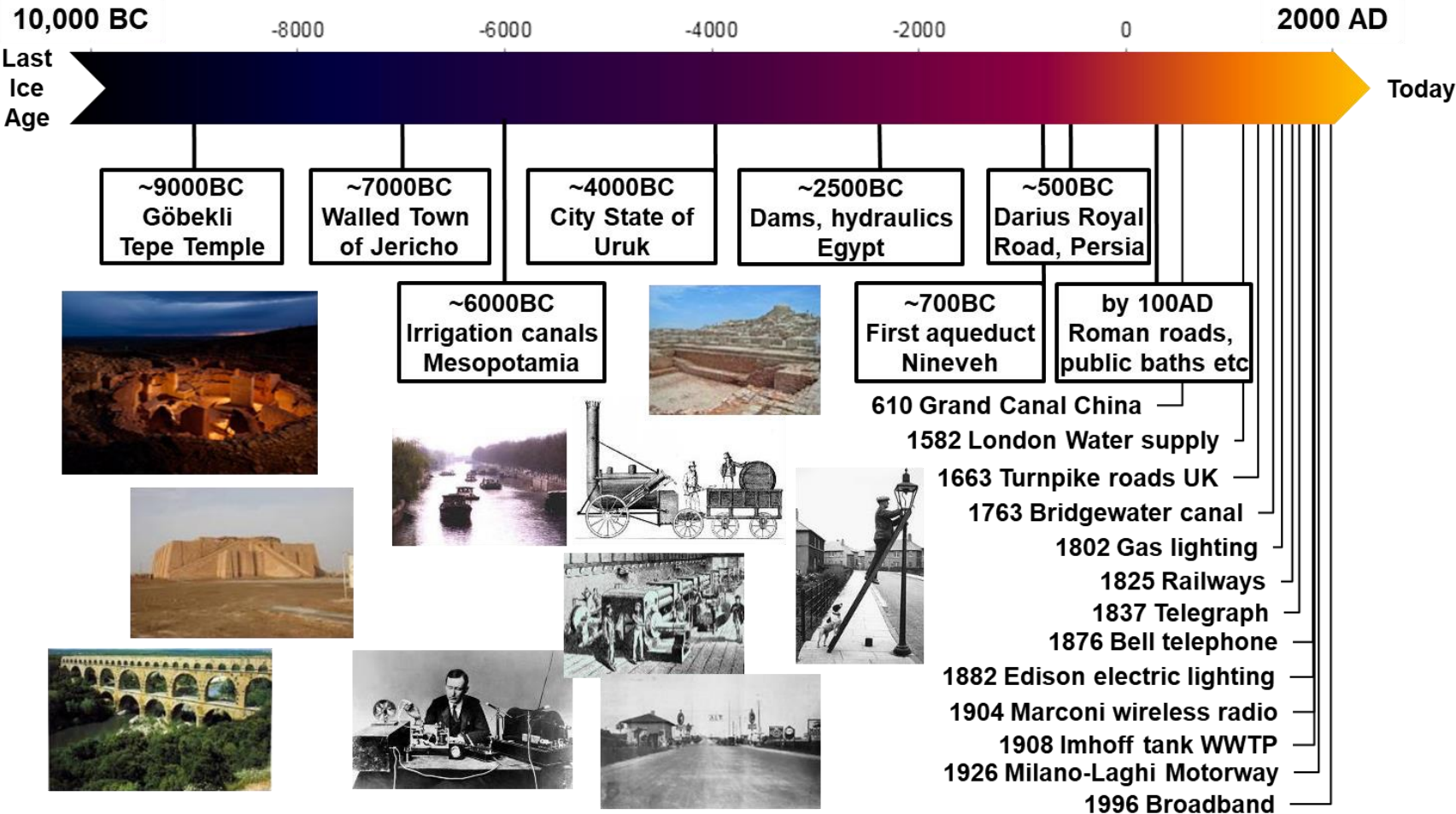
An increasingly inter-dependent, evolving, complex, vulnerable system-of-systems

Trend towards:

Universal Service - Affordability - Sustainability

Postcards from the Past

An Infrastructure Invention Timeline ...



Origins – Göbekli Tepe

- 9000 – 7000 BC in Upper Mesopotamia
- First known large scale construction site
- World's first temple
- Technology = carving, moving & erecting 20t limestone pillars
- 500 workers stopped hunting and gathering over several years



Regulation - Early legal frameworks

Babylonian Code of Hammurabi (1780BC):

- “the building of temples, the adorning of cities, the digging of canals, the making of roads, the framing of laws was his pride”
- private contracts “eye for an eye” (including builders), debt and risk

Solon (elected Archon of Athens in 594BC):

- Officer of Fountains, elected by public vote, responsible to operate and maintain system, enforce regulations and distribute water fairly
- where there was a public well within a hippicon (710 m) all should use that; but if not they could try and procure water of their own;
- owners of private wells forced by regulation to maintain them in good condition and ready to use in case of war

Roman Law of Twelve Tables (450BC):

- established rights of way for public roads with standardized widths

Darius' Royal Road 500BC



- 2700 km from Susa to Sardes
- Military, communication and trade purposes
- 7 days for mounted couriers from end-to-end

"There is nothing in the world that travels faster than these Persian couriers."

- Herodotus

Roman Empire 44BC – 476AD

Infrastructure = Civilisation

- Adapted and improved technology and engineering practices from Greeks, Etruscans, Persians etc.
- Concessions for exploiting infrastructure: postal services, river transport
- Public and Private Legal systems established
- Infra Finance: State; Local; Donations; Taxes; Tolls; Slaves/Military/Contractors



What did the Ancients do for us?

Infrastructure:

- Temples
- Canals
- Cities
- Postal system
- Water supply
- Sanitation/Public baths
- Roads
- Ports

Finance/Resources:

- Slave labour
- Military labour
- Forced labour (corvée)
- Paid labour
- Public funding “*fiscus*”
- Private gifts
- Modest concessions
- Taxes
- User charges/Tolls

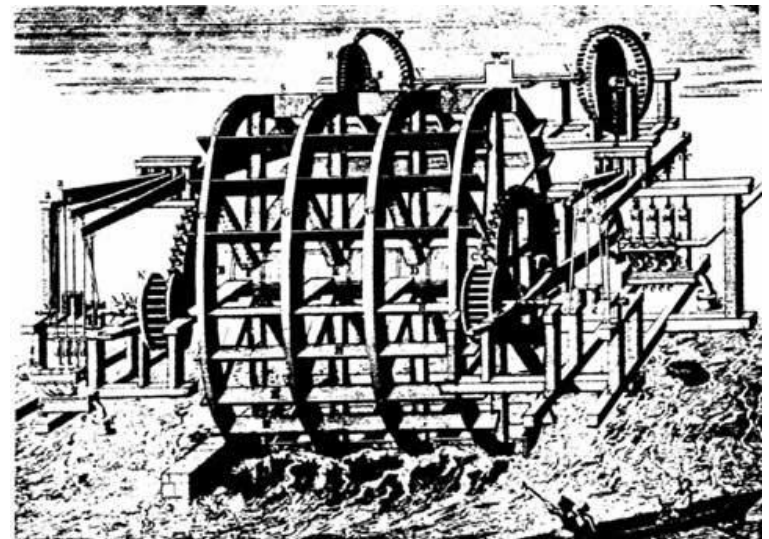
Private infrastructure revolutions

From projects to networks

Infrastructure network	Early Date	Pathfinder project	Lead country	Early adopters
Water supply	1582	London Bridge Co.	UK	France; Belgium
Roads (turnpikes)	1663	Great North Road	UK	USA; Alps
Canals	1761	Duke of Bridgewater canal	UK	France; USA
Gas lighting	1810	London Light & Coke Co.	UK	France; Belgium
Railways	1830	Liverpool & Manchester	UK	Belgium; USA
Telegraph	1846	Electric Telegraph Co.	UK / USA	France
Telephone	1878	Bell Telephone Company	USA	Scandinavia
Tramways	1881	Berlin	Germany	Belgium
Electricity	1882	Pearl Street	USA	Germany; UK
Motorways	1924	Autostrade dei laghi	IT	Germany

1582 – First Private Water Supply

- Letters Patent granted by Elizabeth I in 1578 to Peter Morris to erect a water lifting device in the north arch of old London Bridge and sell water to houses nearby (at £1 per year).
- Finance: £2,500 cost of works –
20% personal equity;
40% grant from the City Sergeant;
40% short term loan from City
- 500 year lease granted for the bridge arch - remained a profitable, family owned business for 120 years
- Purchased by private equity in 1701 for £38,000
- Eventually sold out to the New River Co. in 1822 just before old London Bridge demolished



New River Company

- Originally proposed to Elizabeth I, but approved by James 1st in 1603, restarted works 1609 completed 1613.
- 65km, 3m wide artificial canal from Hertfordshire to Clerkenwell cistern: Cost £19,200 (~ £750m today)
- *Financed by 32 “Adventurers” shares. King James I had to step in for additional 50% of capital due to cost overrun. Granted 500 year rights.*
- *First dividend paid in 1622. Myddelton later bought out the King’s shares just before he died in 1631.*
- ***1888: “The most remunerative and successful of all trading corporations of the world”***
- *Many shareholder perks*



Sir Hugh Myddelton

- *Orig £100 share sold for £125,500 in 1897!*
- *Over 270 years: Labour wages x4; New River dividend x200*
- *Bonds issued in 1860s as speculation over compensation*
- *1904: Municipalized as part of Metropolitan Water Board*

Competition for water supply

- 29 private companies consolidated into 8

8 Main Companies (date founded)

- New River Company (1613)
- Chelsea Waterworks (1723)
- Southwark Waterworks (1760)
- Lambeth Waterworks (1785)
- South London Company (1805)
- West Middlesex Company (1806)
- East London Waterworks (1807)
- Kent Waterworks (1809)
- Grand Junction Waterworks (1811)

1817: Secret deal for local monopoly & transfer of assets across boundaries at 4-5% Return on Capital

London c1856



Economic & Quality Regulation

Waterworks Clauses Act, 1847

Profits of the undertakers to be limited.

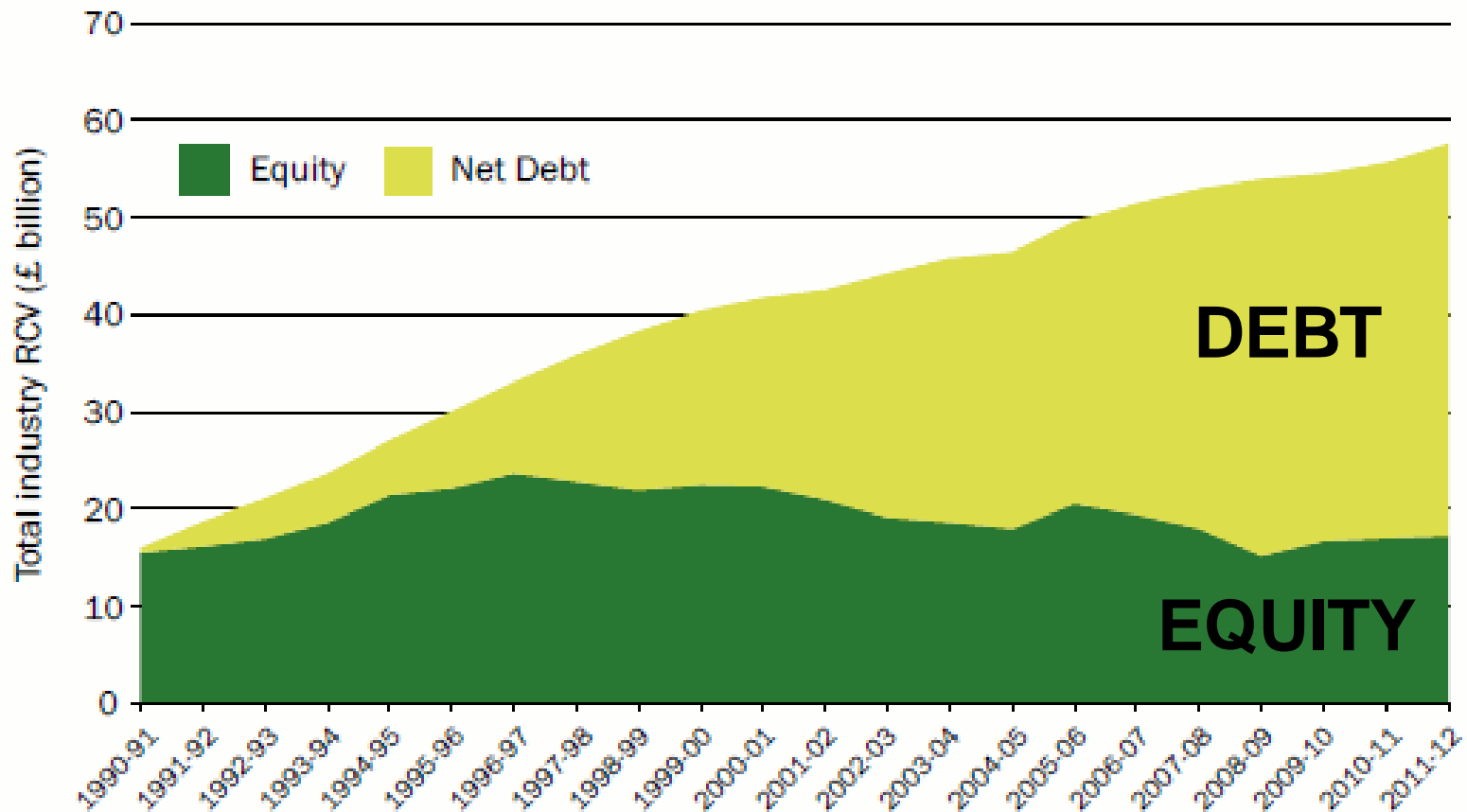
Article 75. *The profits of the undertaking to be divided among the undertakers in any year shall not exceed the prescribed rate, or where no rate is prescribed they shall not exceed the rate of ten pounds in the hundred by the year on the paid-up capital in the undertaking, which in such case shall be deemed the prescribed rate, unless a larger dividend be at any time necessary to make up the deficiency of any previous dividend which shall have fallen short of the said yearly rate.*

Metropolis Water Acts of 1852 & 1871:

- *Appointed a “**Water Examiner**” – Continuous supply & quality standards plus financial reporting to Parliament*

Back to the future

Gearing at the English and Welsh water companies since privatisation



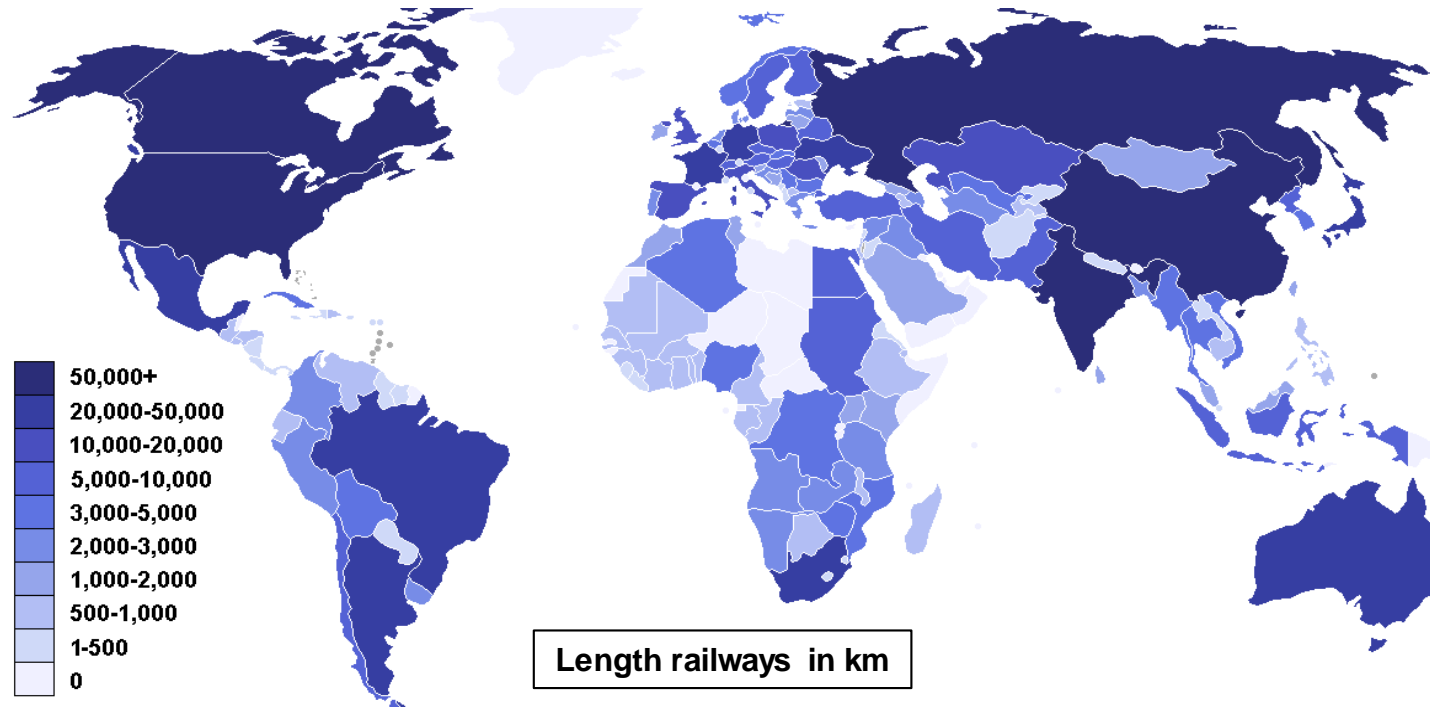
Source: Ofwat

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London's water services

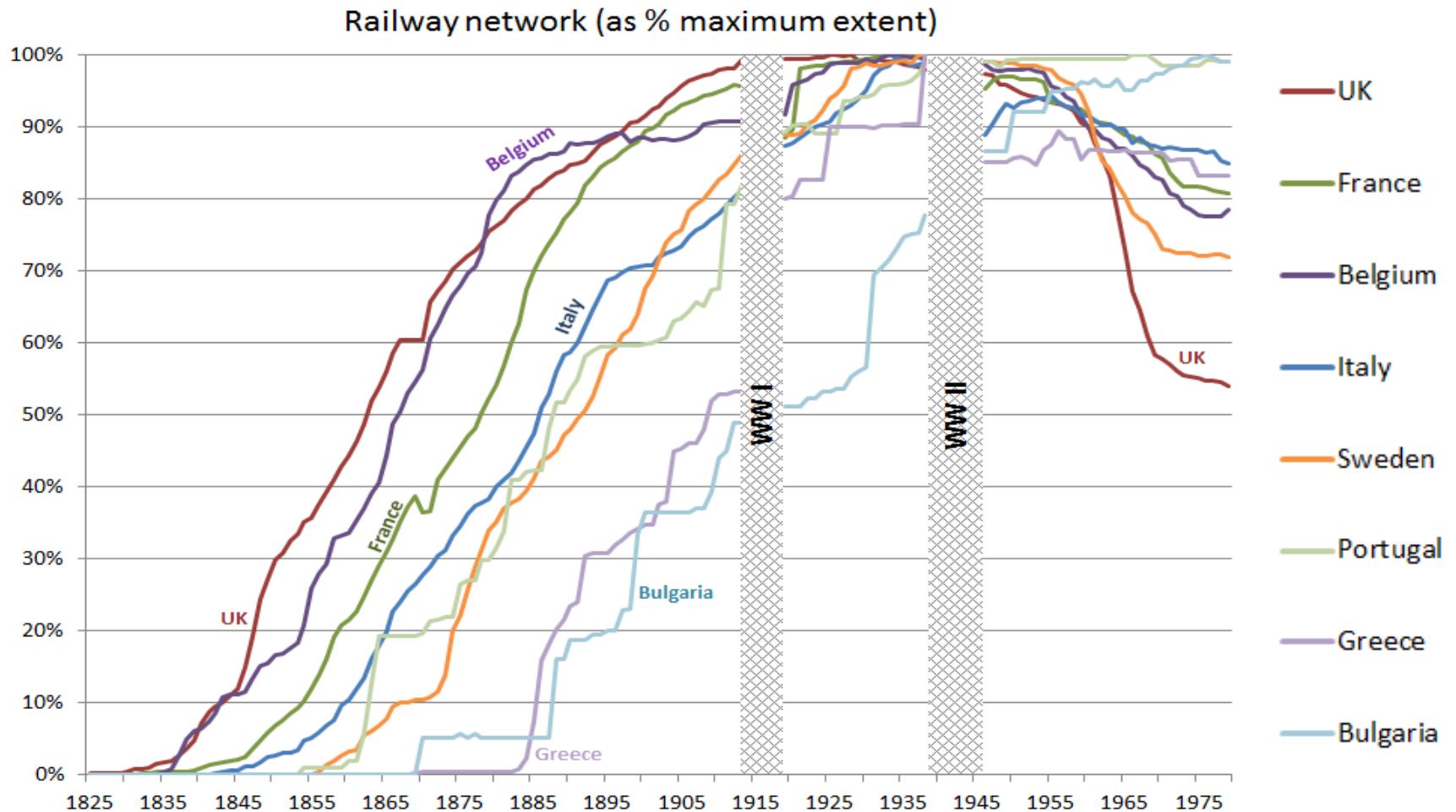
Year	Events / Company founded	Finance
100	Roman bucket-and-chain water wheel	Taxes (+ Slavery)
1237	Great Conduit (King + Grants + Bequests)	Grants
1582	London Bridge Waterworks Co. (private)	Equity + grant
1613	New River Company (private)	Equity
1723	Chelsea Waterworks Company (private)	Equity
1904	Re-municipalisation as Metropolitan Water Board	Bonds
1975	Thames Water Authority	Debt
1989	Privatisation – Thames Water PLC	IPO Equity
1990s	Thames Water WASC	Debt
2011	Maquarie Infra Fund purchase	Private Equity
2015	Thames Tideway Project	PF + Guarantee

Railways changed everything ...



Virtually all forms of modern finance were developed in the context of global railway investment with English, Dutch, French, German and US capital attracted around the world by a wide range of subsidy & guarantee mechanisms

Leaders and followers had different financing strategies



Source: Goldsmith (2015)

Blending mechanisms (subsidies)

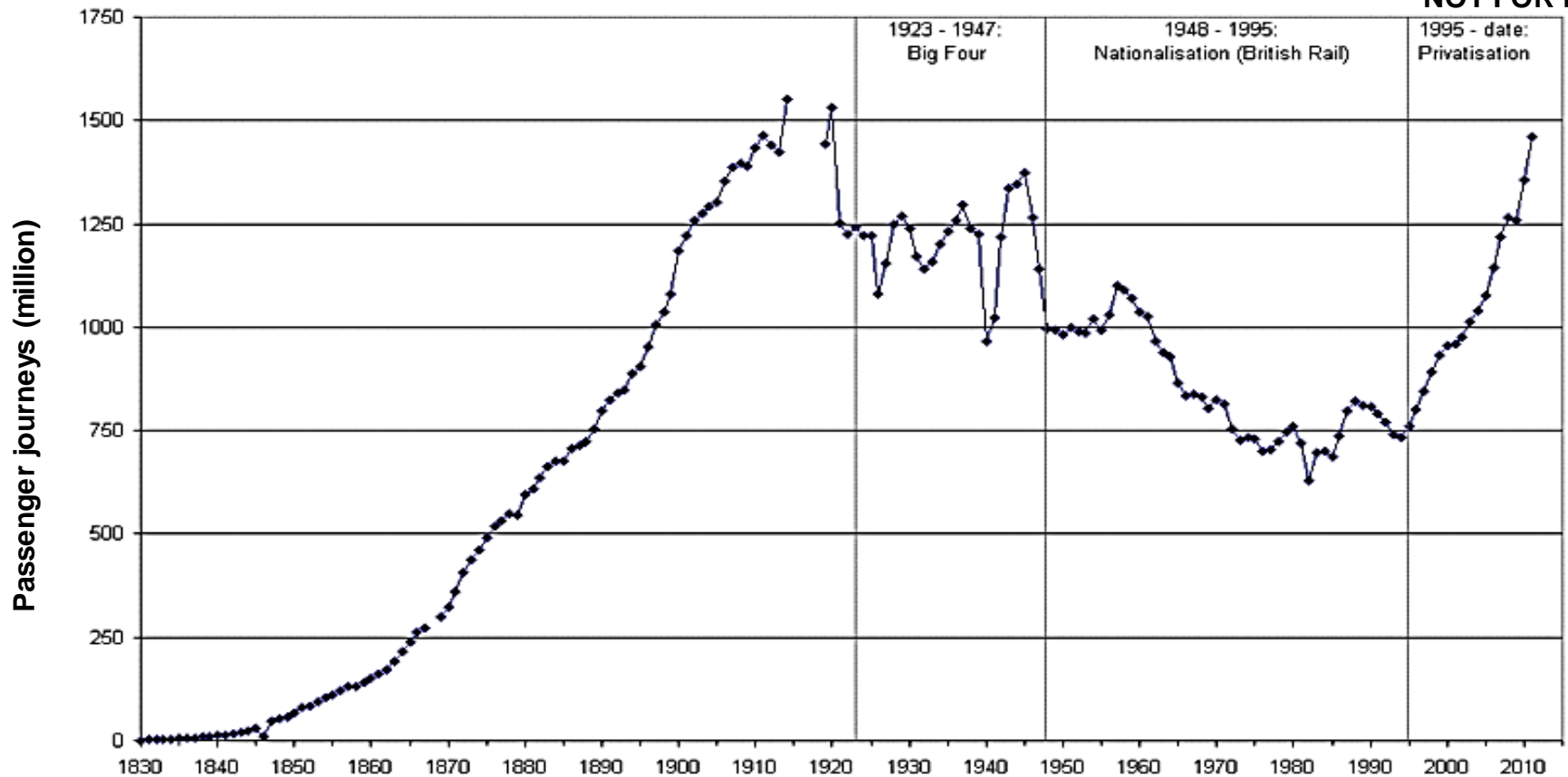
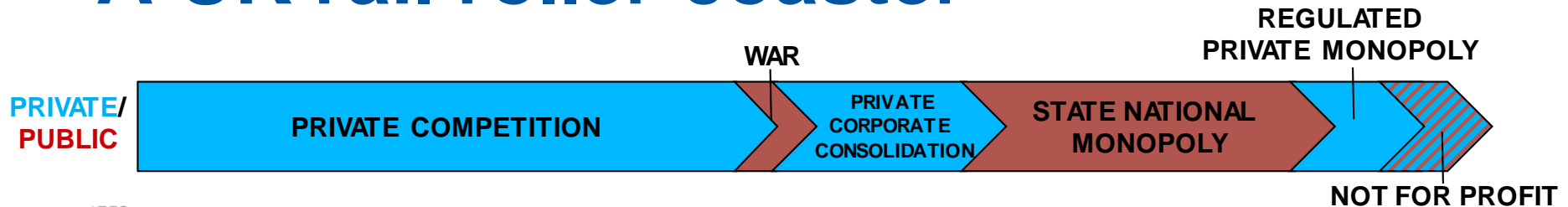
London Stock Exchange Year Book 1883

“... deprived of the power in most cases of issuing direct loans, several foreign governments have given guarantees for railways and other national works, and in this way means have been obtained.”

Examples of foreign investment incentives:

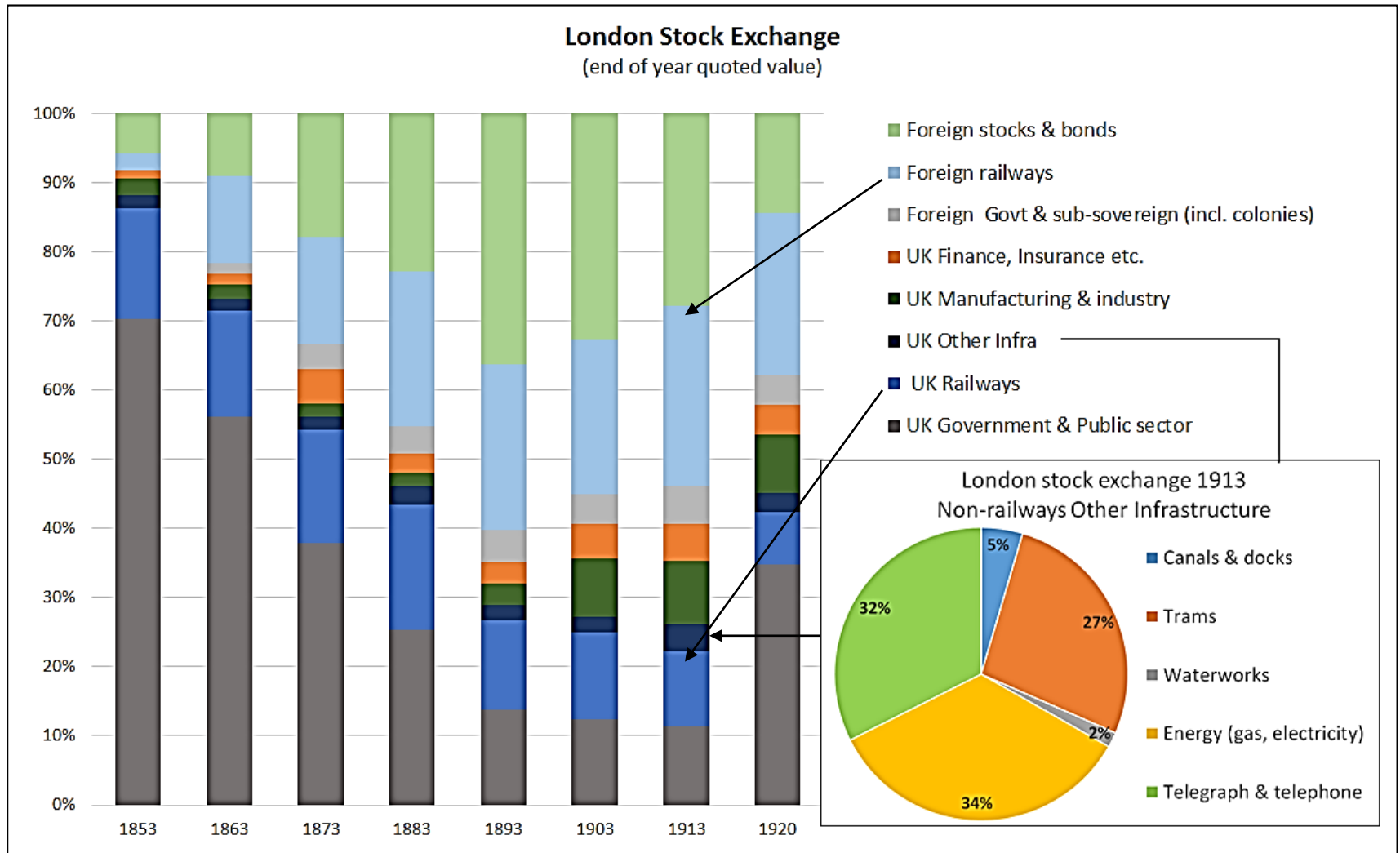
- Principle and interest guarantees on bonds
- Payment per km constructed
- Land grants & land value capture
- Very long concessions
- Upfront grants

A UK rail roller coaster



Capital market evolution

By 1913, domestic and foreign railways represented almost 40% of stock market

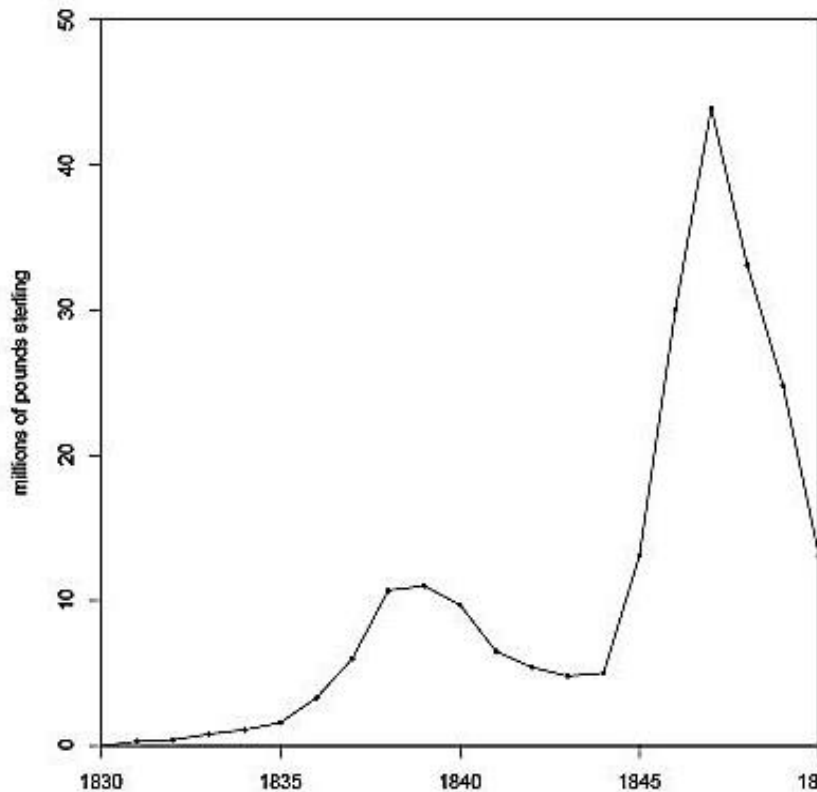


Source: Goldsmith (2015)

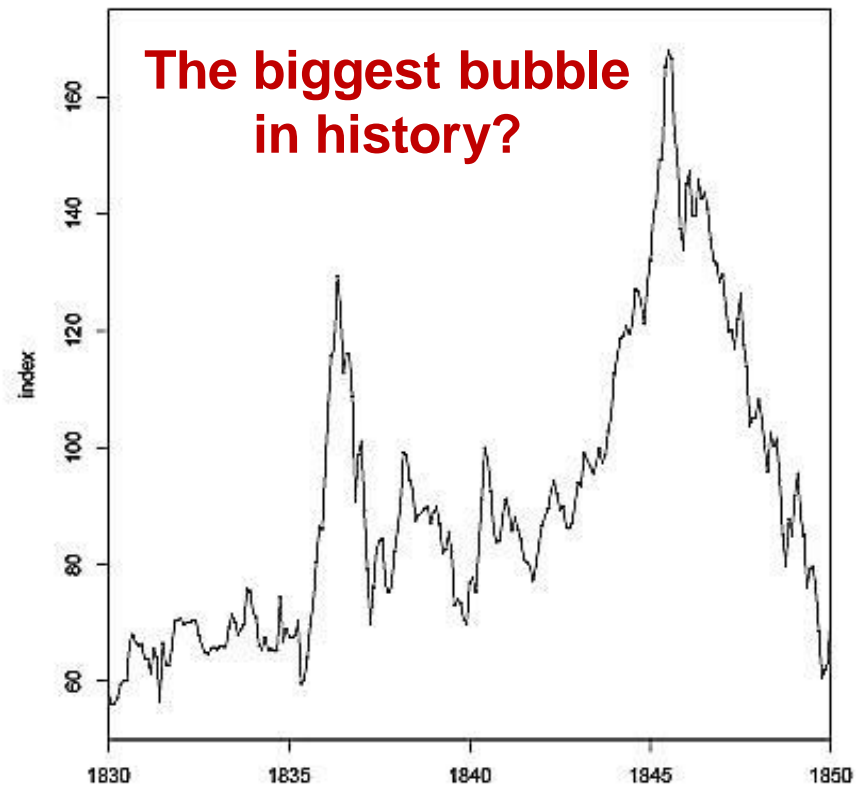
Railway Manias: 1835-38 & 1842-47

Infrastructure bubble finance

British railway capital investment



Index of British railway share prices



Source: Campbell & Turner (2010)

Post WWII: new technology, old dilemmas

Institutions/Finance:

- 1946 Creation of World Bank (IBRD)
- 1947 \$13bn Marshall Plan
- 1958 Creation EEC and EIB
- 1963 First Eurodollar bond Autostrade
- 1970s Restart global project finance
- 1986 UK Utility privatisations start
- 1991 First Infrastructure Fund
- 1992 Launch of UK PFI programme
- 1990s Blended PPPs
- 2007 Start global financial crisis
- 2010 UK National Infrastructure Plan
- 2015 New guarantee instruments

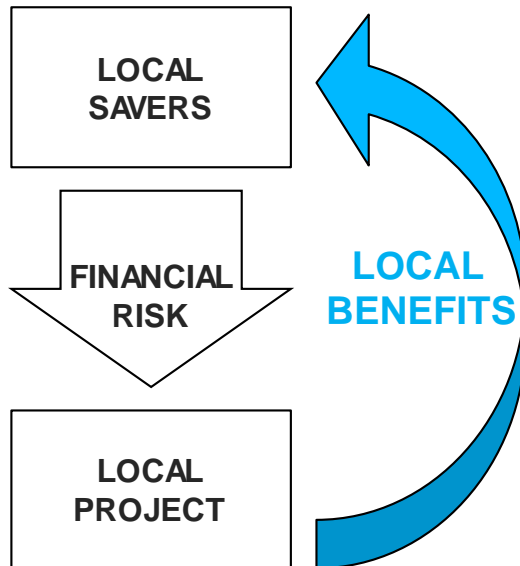
Technology:

- 1950s First Nuclear power stations
- 1960s Motorway programmes
- 1980s Internet commercialized
- 1983 1G GSM launched
- 1991 First offshore windfarm (DK)
- 1996 Start Broadband
- 1996 GPS declassified for commerce

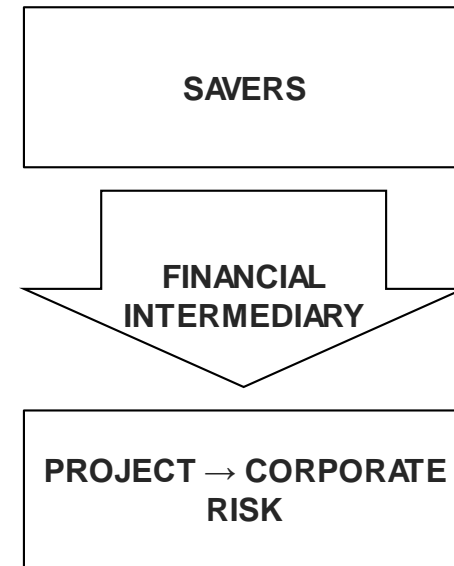
**Increasingly regulation
drives old technologies,
markets drive new ones.
Re-emergence global finance
Multinationals & Multilaterals**

Laissez-faire: supply-side finance

Local Market:



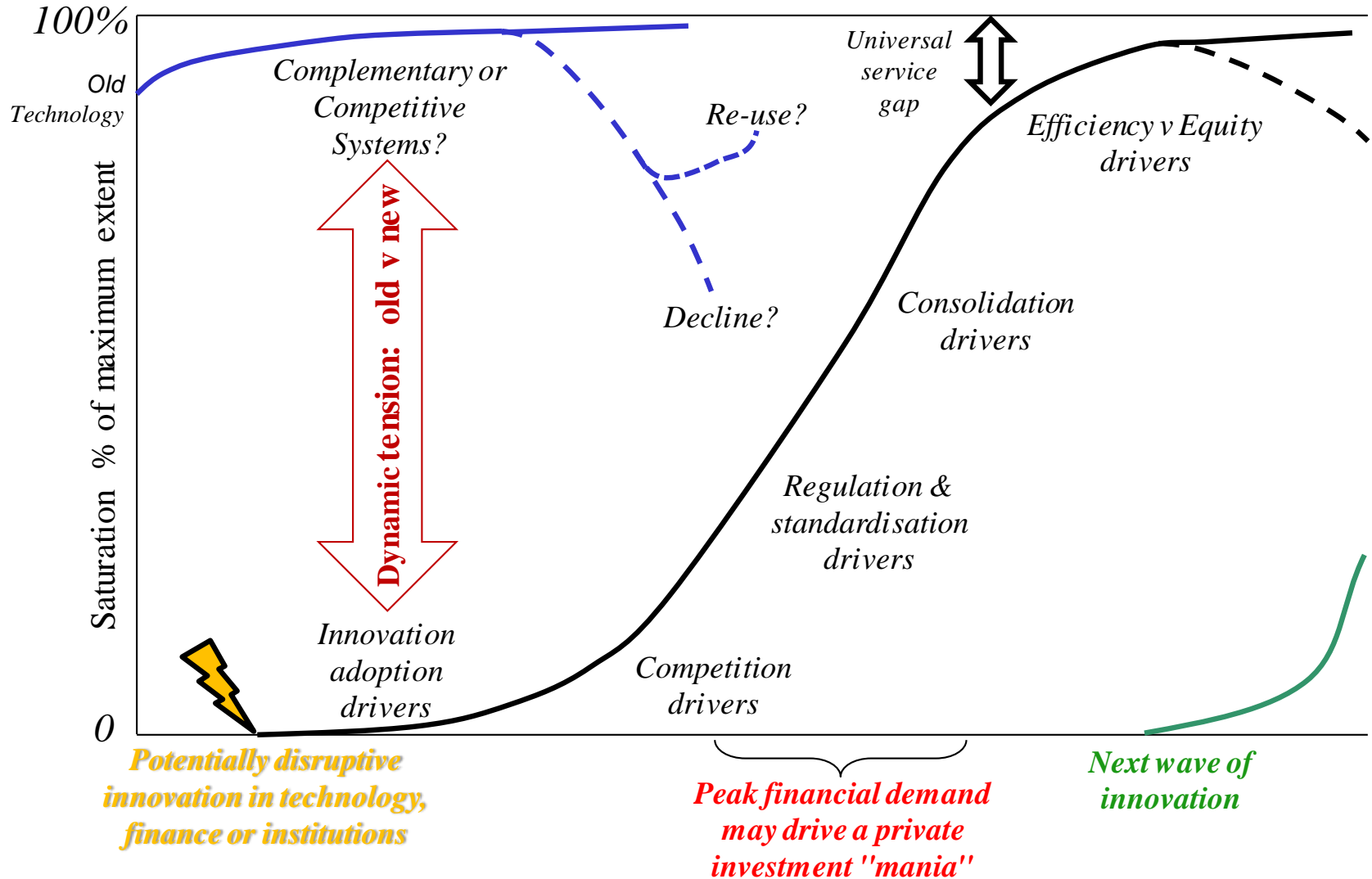
National Market:



Global Market:



The infrastructure investment cycle

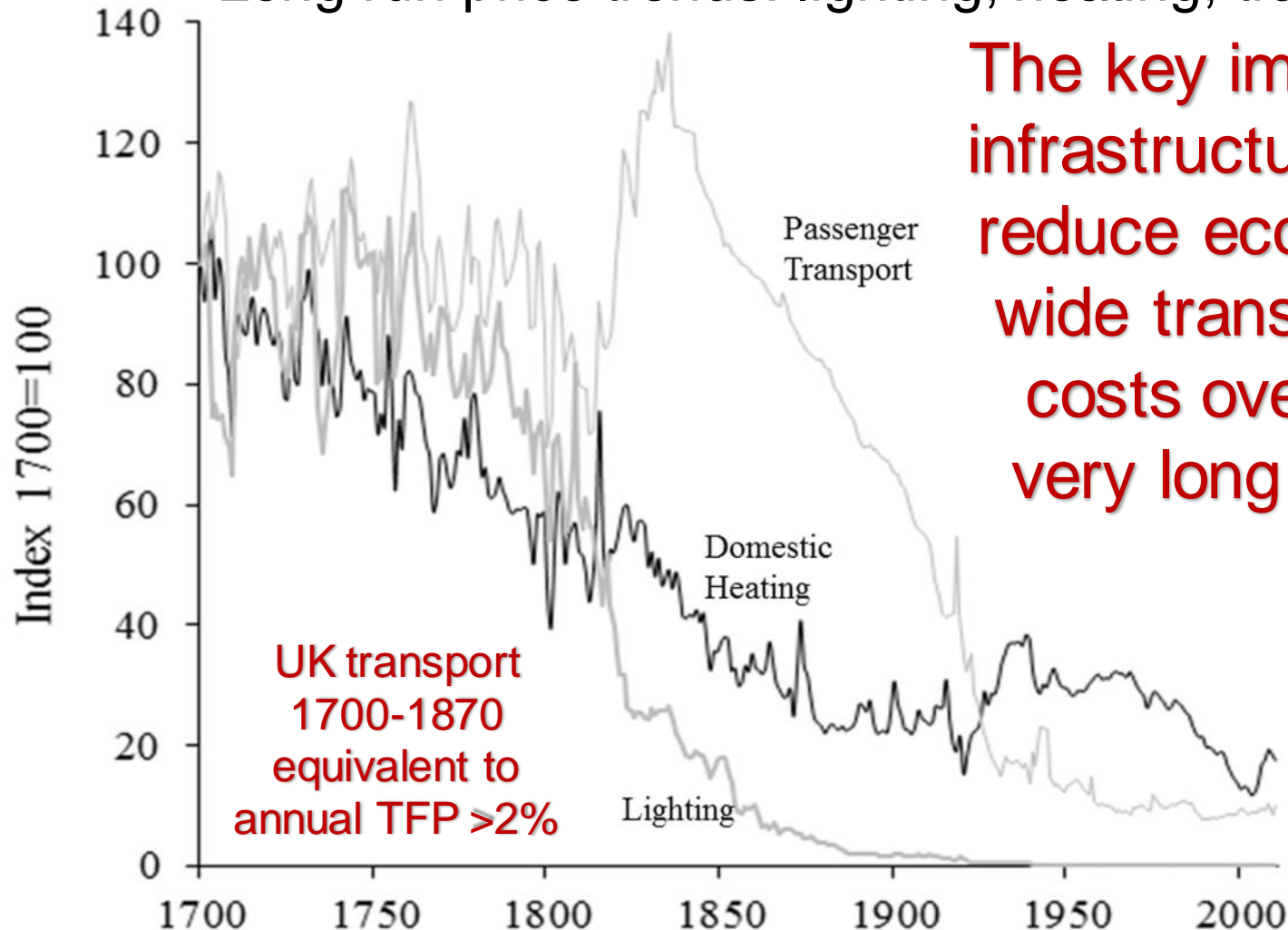


Source: Goldsmith (2015)

Economic impact

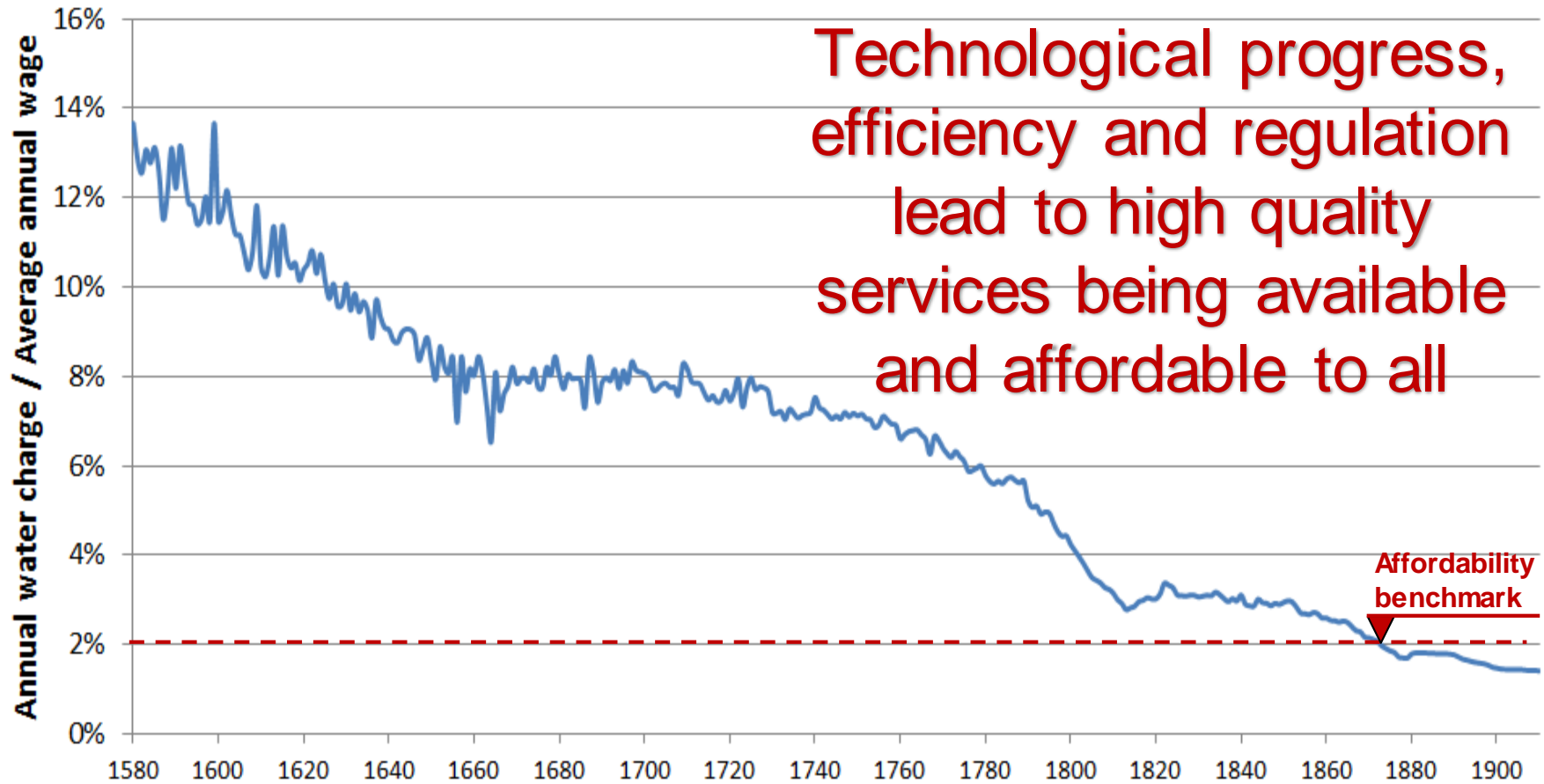
Long run price trends: lighting, heating, transport

The key impact of infrastructure is to reduce economy-wide transaction costs over the very long term.



Affordability of water services

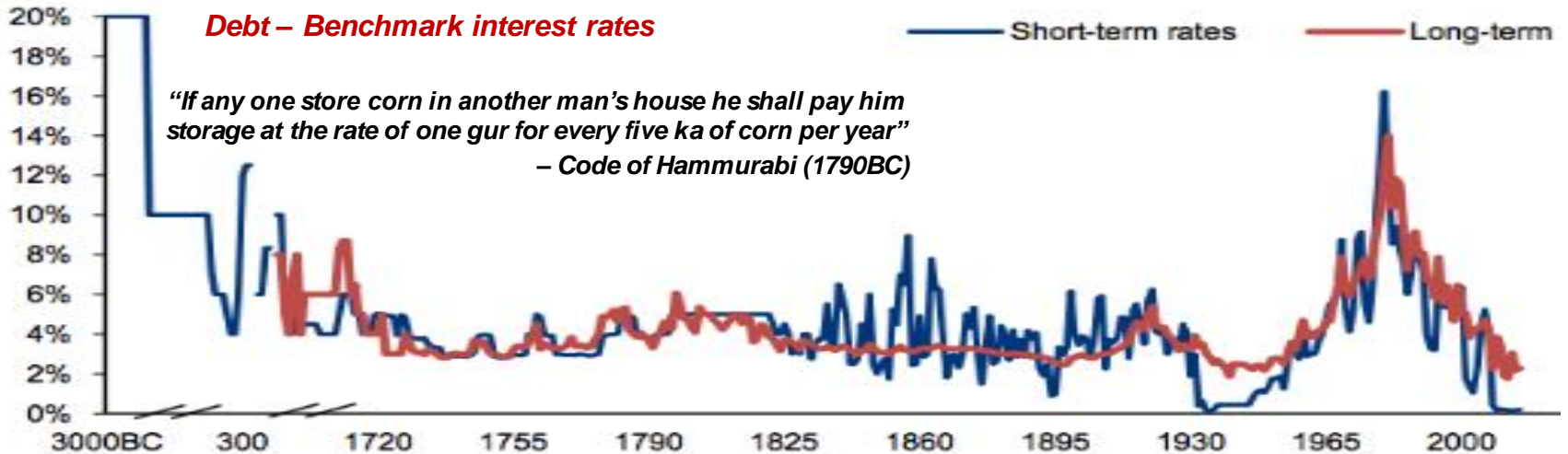
London household water supply typical costs



Technological progress,
efficiency and regulation
lead to high quality
services being available
and affordable to all

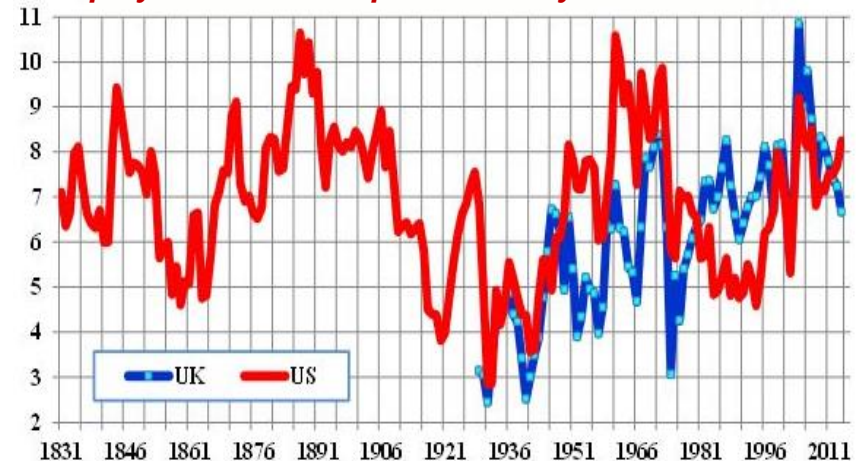
Source: Goldsmith & Carter (2016)

Long term cost of capital



Source: Bank of England (2014) based on Homer & Sylla

Equity Returns over previous 30 years



Source: Smithers (2015) - FT

Debt: 3 - 6%

Equity: 4 - 8%

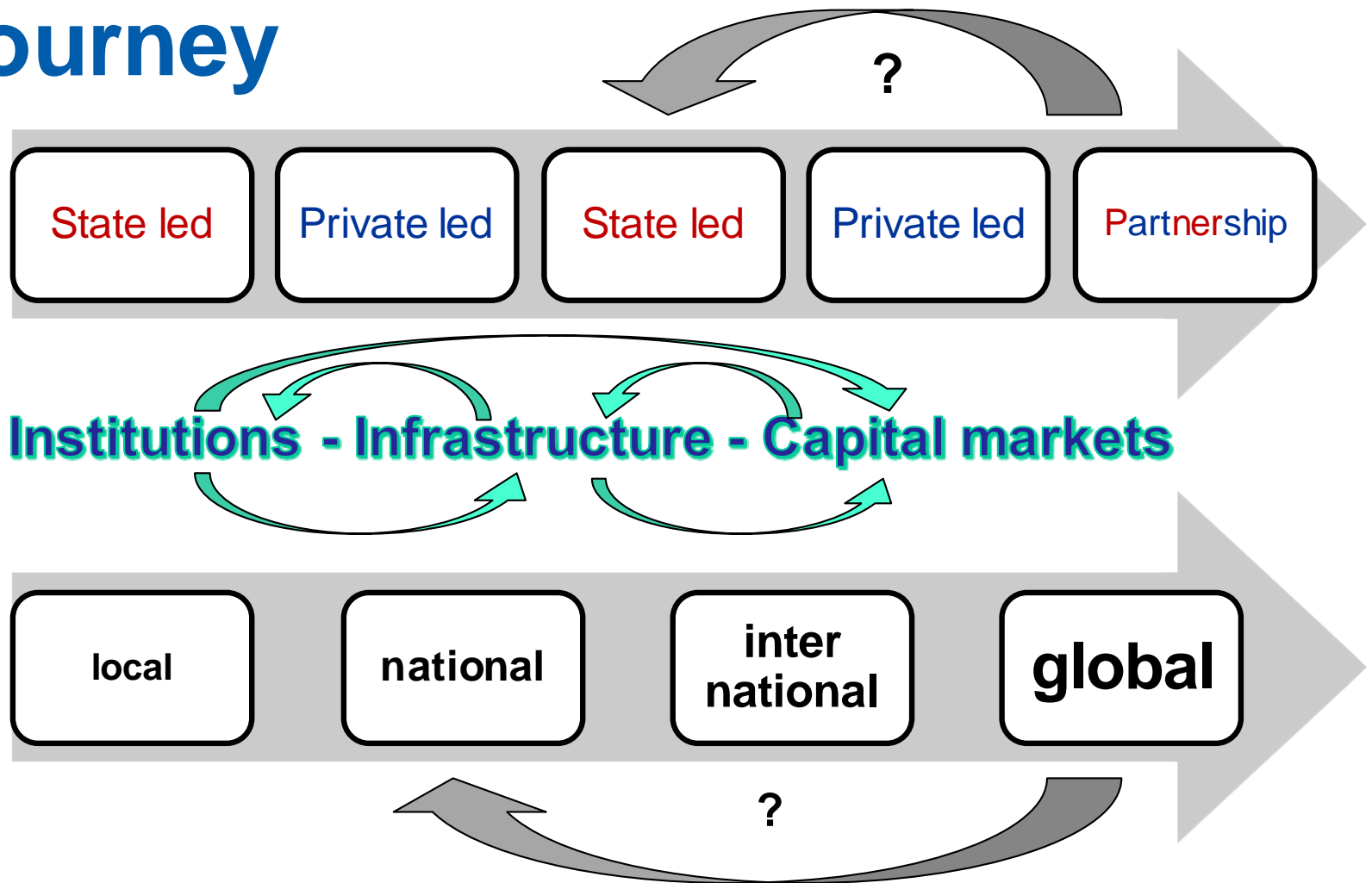
UK Railways 1830-1920 average
 WACC (stocks & shares): 4.39%

Synthesis: Themes - Complexity

Infrastructure services evolve in technical/economic/social context:

- Labour v capital (slavery → labour markets → mechanisation)
- Demand v Pricing policy (free → user charges → tariff structure)
- Competition v Contract v Regulation (natural consolidation trend)
- Actors (Public → Private → Partnership → Not-for-Profit)
- Capital (Domestic → FDI → Domestic)
- Financial instruments (Grant → Debt → Equity → Guarantees)
- Subsidy mechanisms (Land grants/per km/soft loans/guarantees)
- Institutions v Governance (Legal frameworks/Corruption/Politics)
- Invisible hand v Hidden hand

History is not a deterministic journey



What can we learn from history?

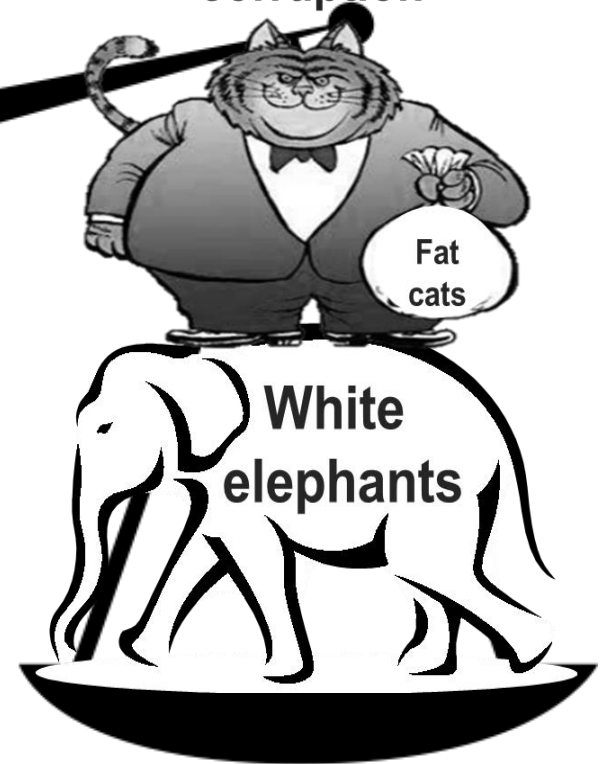
- Economic fundamentals matter
- Infrastructure pay-offs are long term & systemic
- History (and economics) not deterministic
→ path dependency & context matter
- Many paths: UK v Europe v US v China
- Projects rhyme through time
- Recurrent risks:
 - **Optimism bias**
 - **Events**
 - **Politics**

Balancing risks

High quality, affordable,
infrastructure services



Political projects,
corruption



**Good governance
helps balance
risks to society**

What can we learn from 11,000 years of infrastructure finance?

Read some history

Try to learn

Make some mistakes

Learn from your mistakes

Learn from others

Make more mistakes

Write some history

WISDOM



Thanyou!
Danke!

Fragen?

(auf Englisch bitte!)