



A History of Infrastructure Finance

EIB Institute Lunchtime Talk
06.04.2016

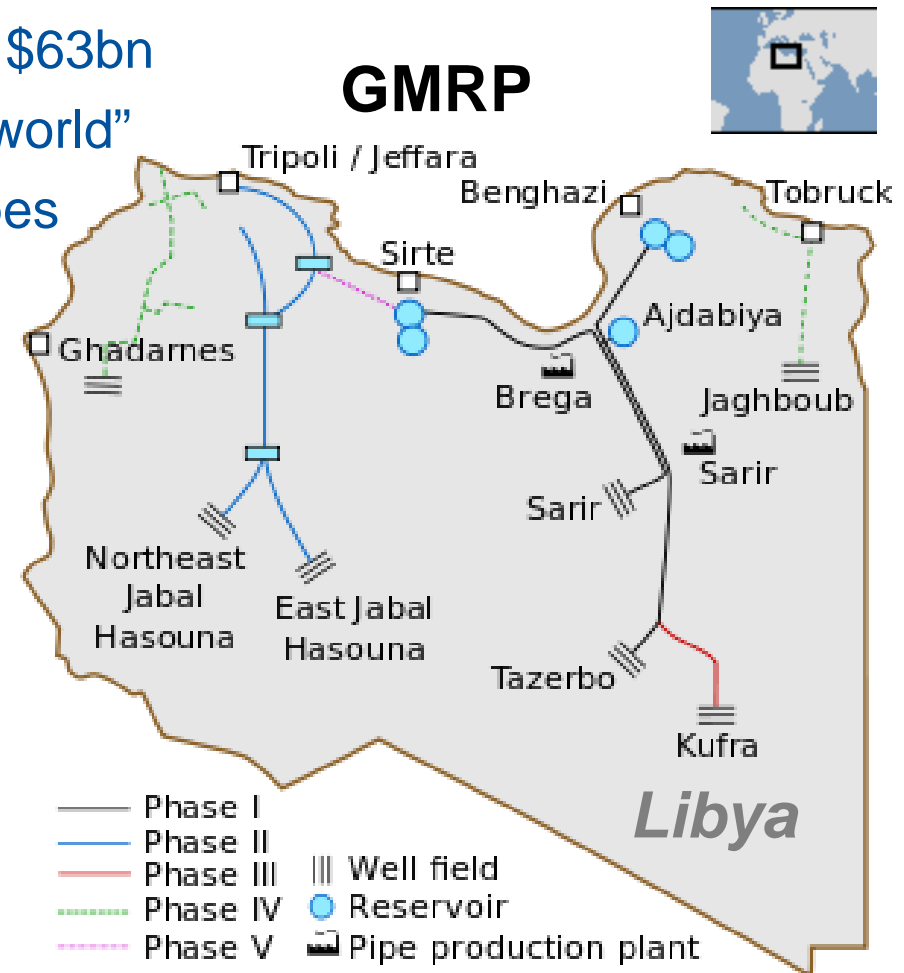
Hugh Goldsmith
EIB - JASPERS

Topics

1. Personal perspective
2. Ancient world
3. Water for London (& beyond)
4. More projects and networks
5. Big picture
6. Synthesis?

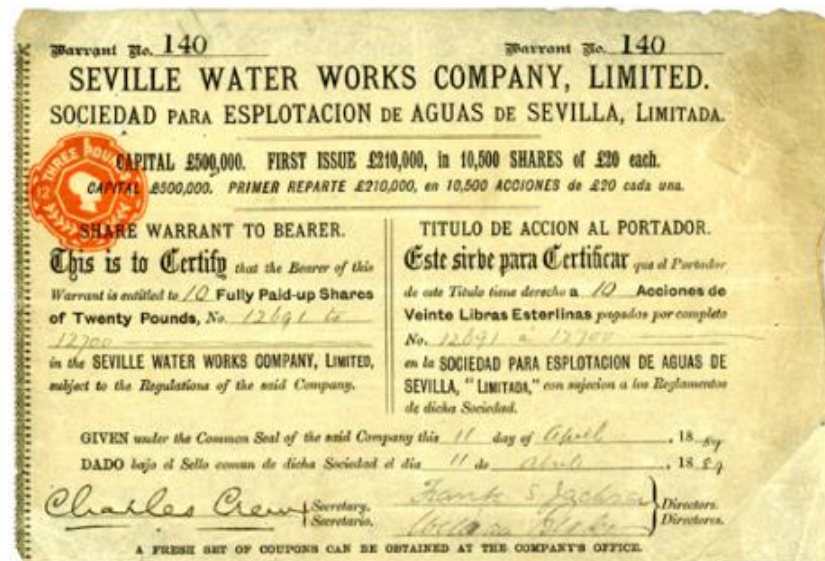
You can potentially finance anything but should you build it?

- Libya: Popl'n = 6.2 million / GDP \$63bn
- Gaddafi's "Eighth wonder of the world"
- 2800km of up to 4m diameter pipes
- Cost = ~ \$25bn (Phase I to III)
- Paid for in oil (no debt)



Water supply to Seville

- Appraisal for EIB 2001
- Book ***El Agua en Sevilla*** gives history from Roman times to modern day
- In 1882, Seville granted a 99 year Concession to Seville Water Works Company Ltd (la Compañía de los Ingleses) which floated on London Stock Exchange in 1883
- Concession given up in 1957



EIBURS 2011-2013

A History of European Infrastructure Finance

Bauhaus-Universität
Weimar

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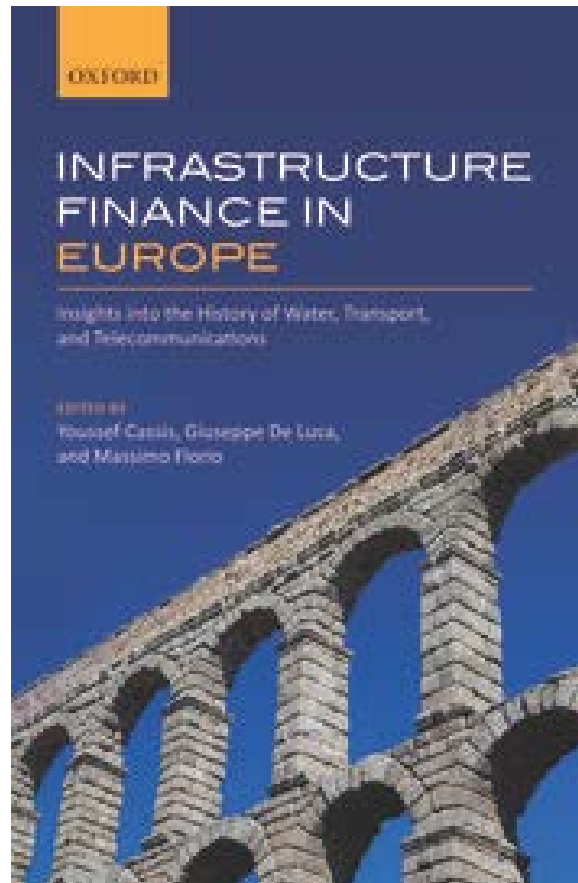


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DI MILANO

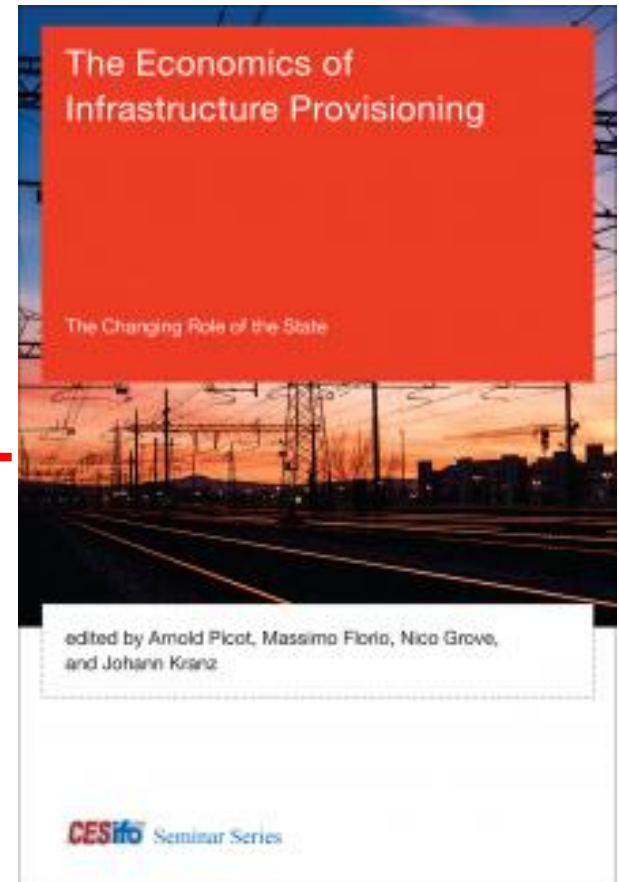
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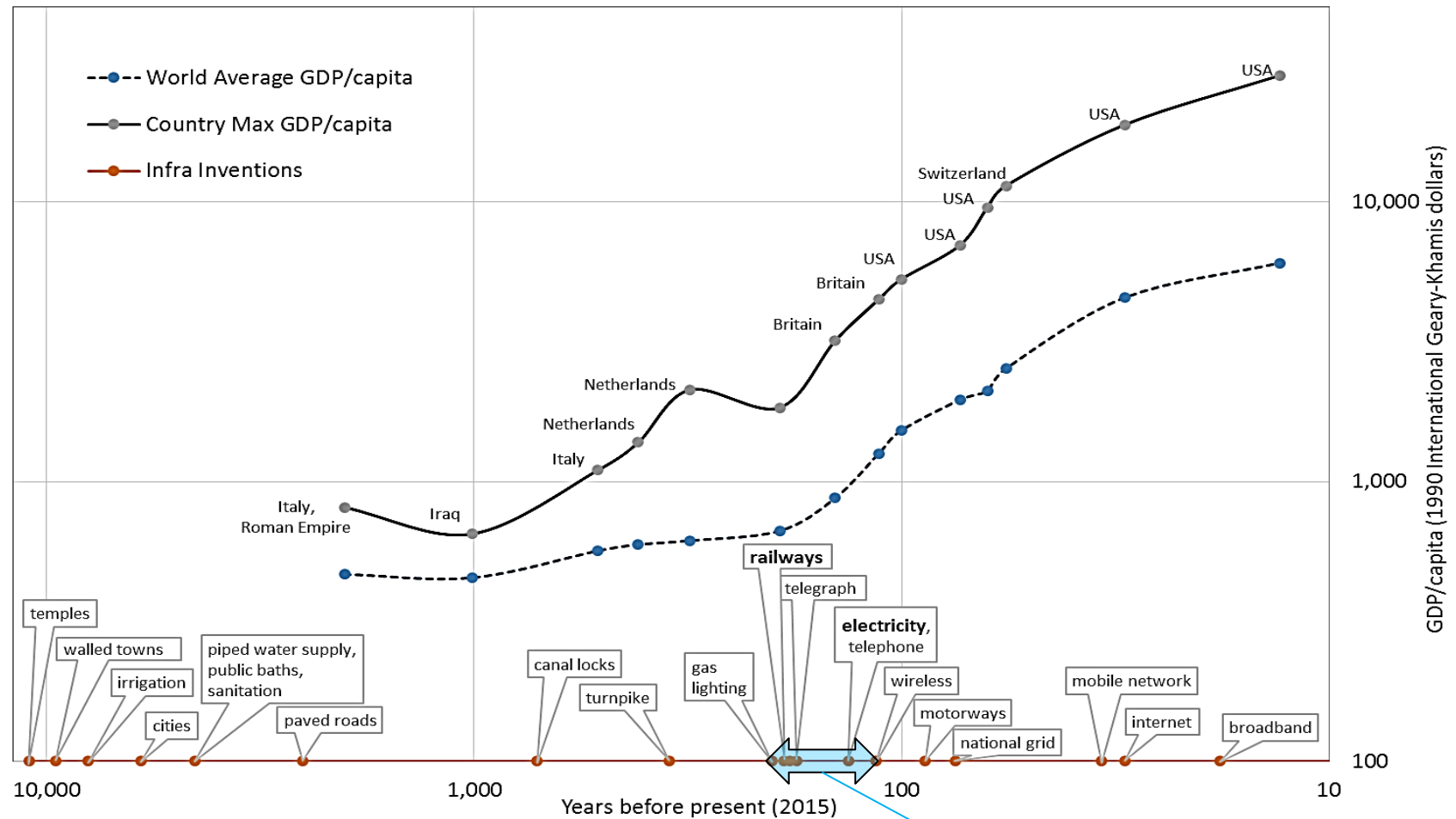


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Infrastructure timeline: 11,000 year history

Long Run Global GDP/capita & Infrastructure Inventions



Source: Goldsmith (2015)

ANCIENT WORLD

Origins – Göbekli Tepe

- 9000 – 7000 BC in Upper Mesopotamia
- First known large scale construction site
- World's first temple
- Technology = carving & moving 20 ton limestone pillars
- 500 workers stopped hunting and gathering over several years



500BC – Transport + Communication



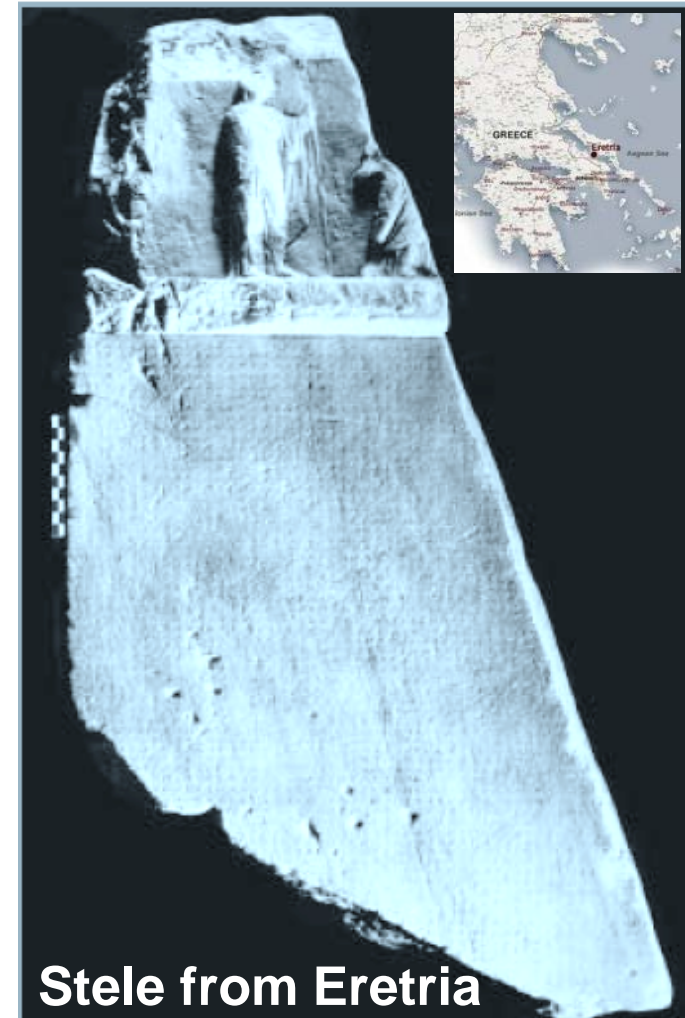
- Darius' Royal Road 2700 km from Susa to Sardes
 - Military, communication and trade purposes
 - 7 days for mounted couriers from end-to-end
- "There is nothing in the world that travels faster than these Persian couriers."
- Herodotus

The First PPP Contract?

Contract of Eretria (~300BC)

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

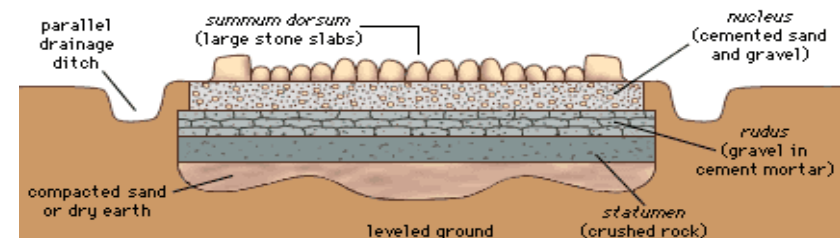
- *all expenses paid by the contractor plus lump sum of 30 talents paid to the City*
- *contractor granted exclusive right to cultivate and retain the products of the reclaimed land for 10 years*
- *exemption of local taxes and some laws*
- *4 year schedule, extended in case of war*
- *obligation on 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)*



Roman Empire 44BC – 476AD

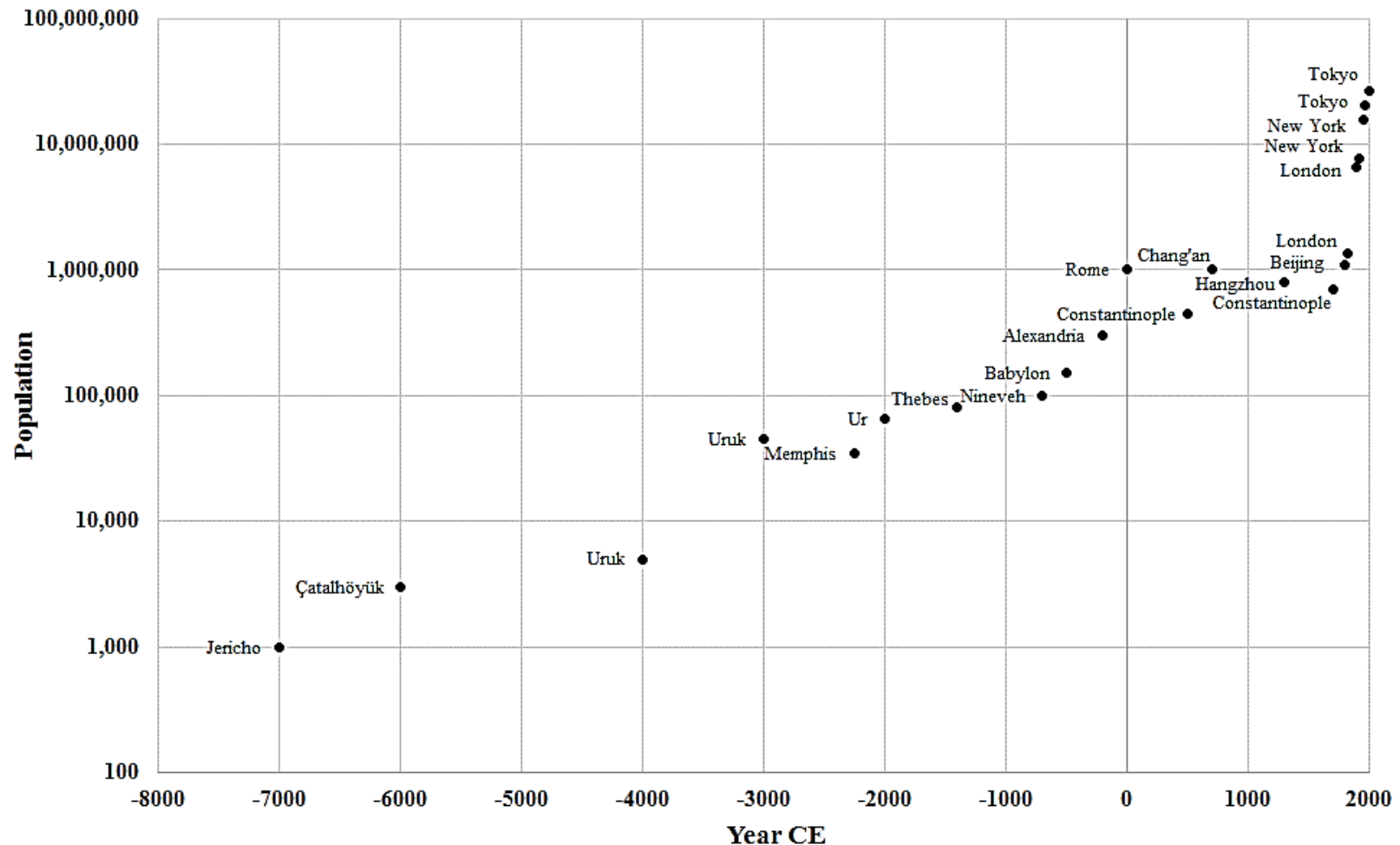
Infrastructure = Civilisation

- 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



Infrastructure supports urbanisation

World's Largest Cities



What did the Ancients do for us?

Infrastructure:

- Temples
- Canals
- Cities
- Theatres/Stadia
- Water supply
- Sanitation/Public baths
- Roads
- Ports

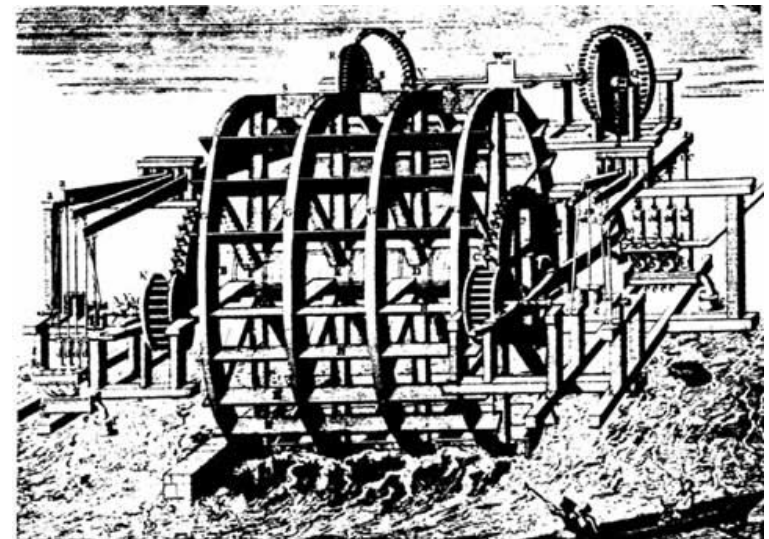
Finance/Resources:

- Slave labour
- Military labour
- Paid labour
- Gifts
- War booty
(reverse grants)
- Modest concessions
- Taxes
- User charges/Tolls

WATER FOR LONDON (& BEYOND)

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 connections to houses nearby
- 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, 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.
- *Myddelton later bought out the King’s shares, but the Company never paid a dividend in Sir Hugh’s lifetime*
- **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 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)

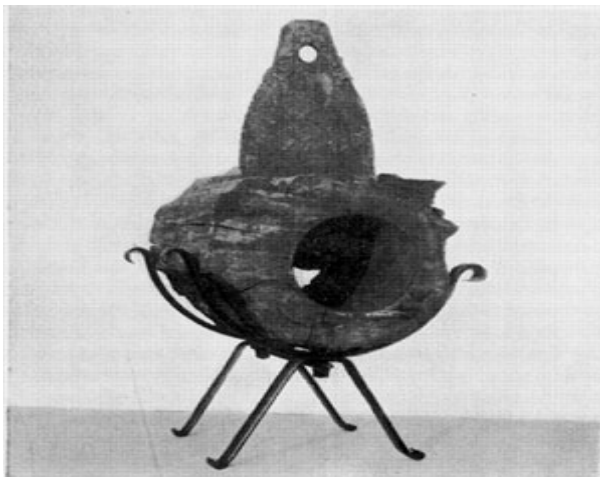
- **New River Company (1613)**
- Chelsea Waterworks (1723)
- Southwark Waterworks (1760)
- Lambeth Waterworks (1785)
- South London Company (1805)
- West Middlesex Company (1806)
- East London Waterworks (1807)
- Kent Waterworks (1809)
- Grand Junction Waterworks (1811)

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

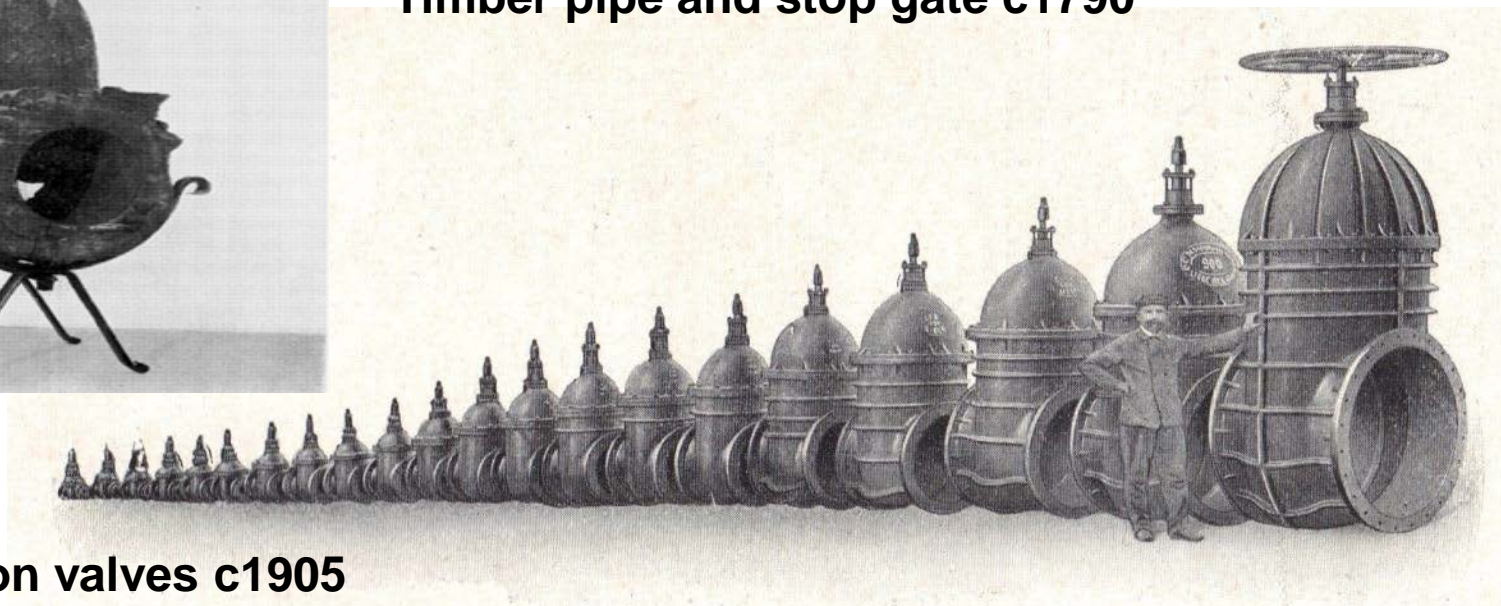
London c1856



The century of technological progress



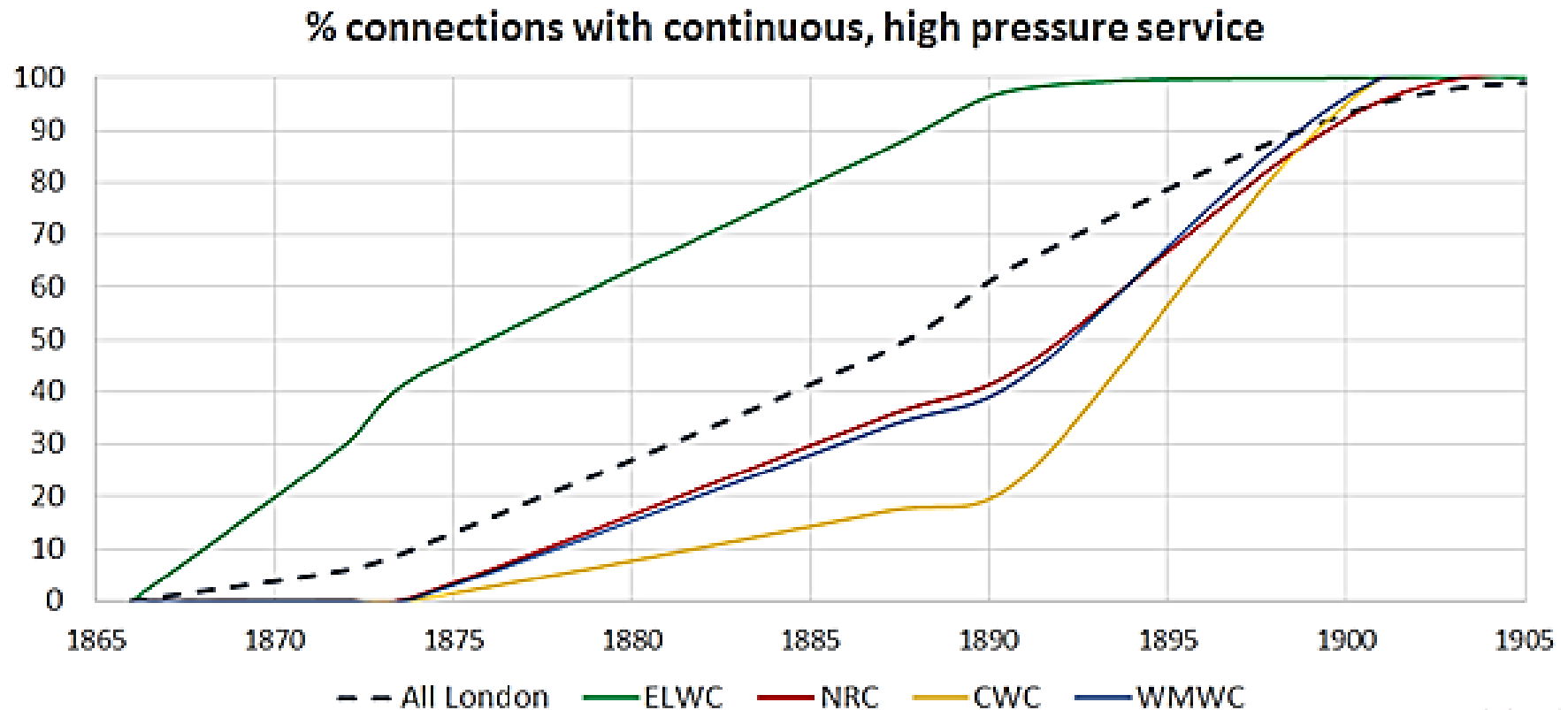
Timber pipe and stop gate c1790



Cast iron valves c1905

- New River Co. relatively slow to innovate
- Wood pipes started to be replaced by cast iron in 1805
- New investments driven by competition & regulation

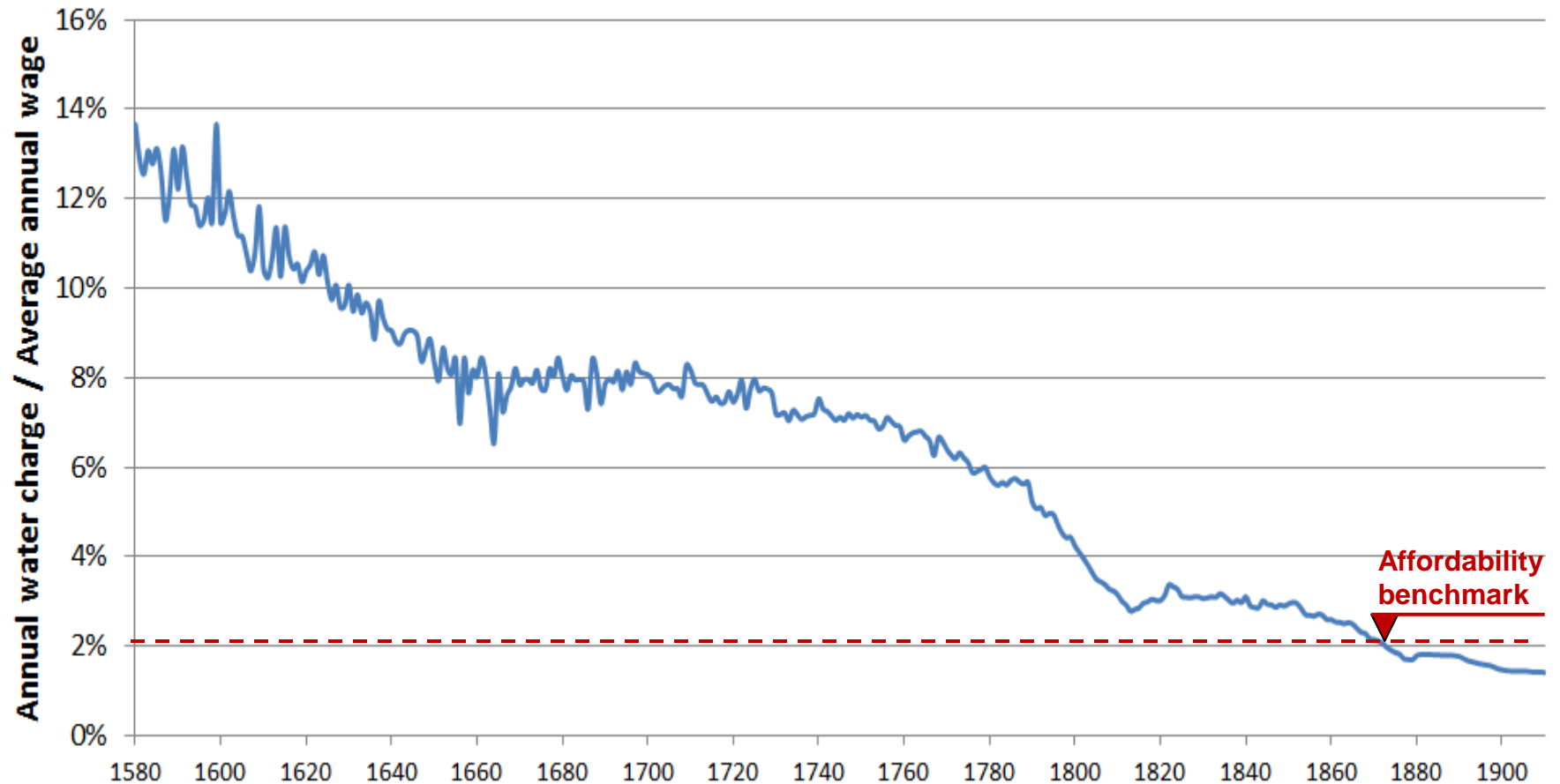
London: Continuous service coverage



Source: Hardy (1991)

Standard nominal water charge

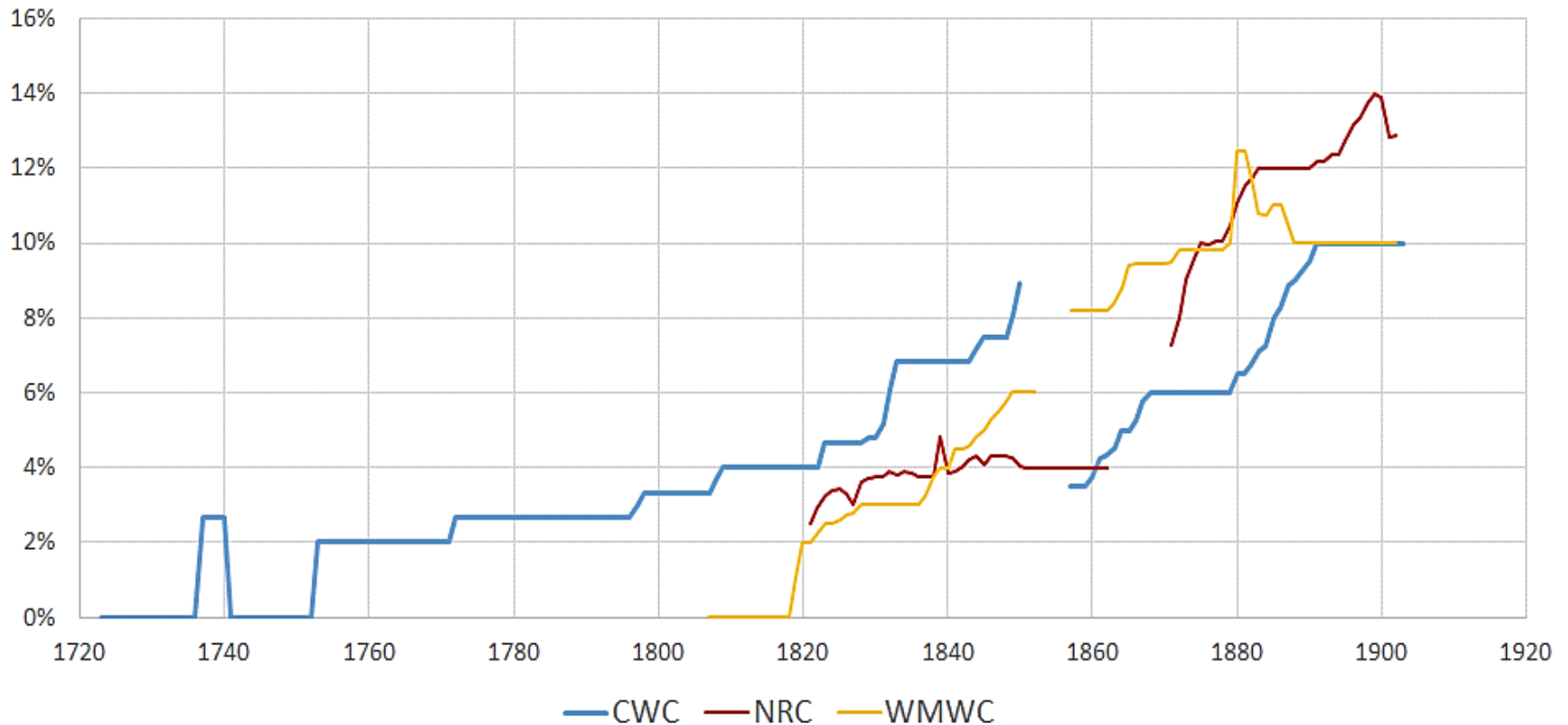
Affordability of annual water supply charge of £1



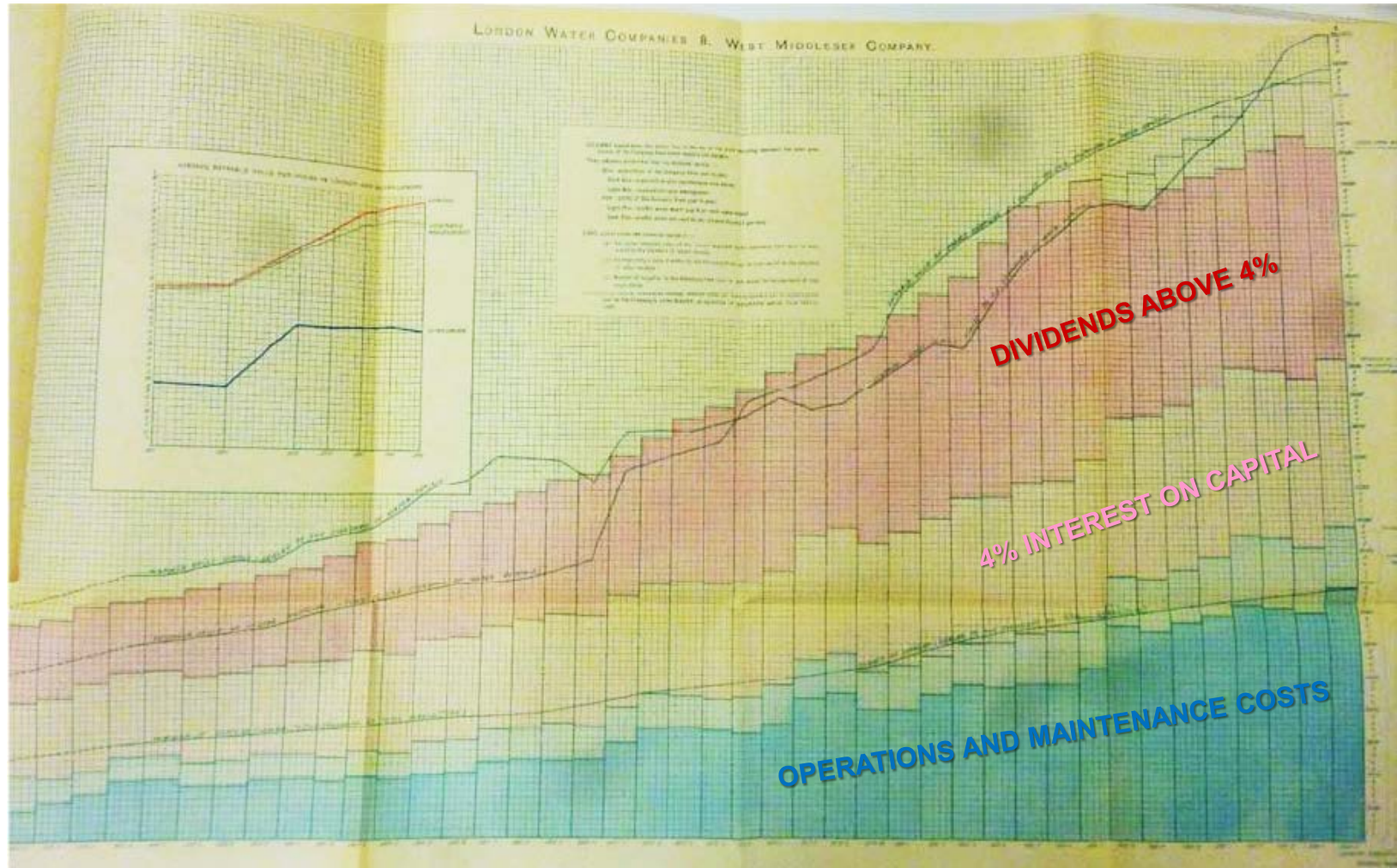
Source: Goldsmith & Carter (2016)

Long run profitability of water supply

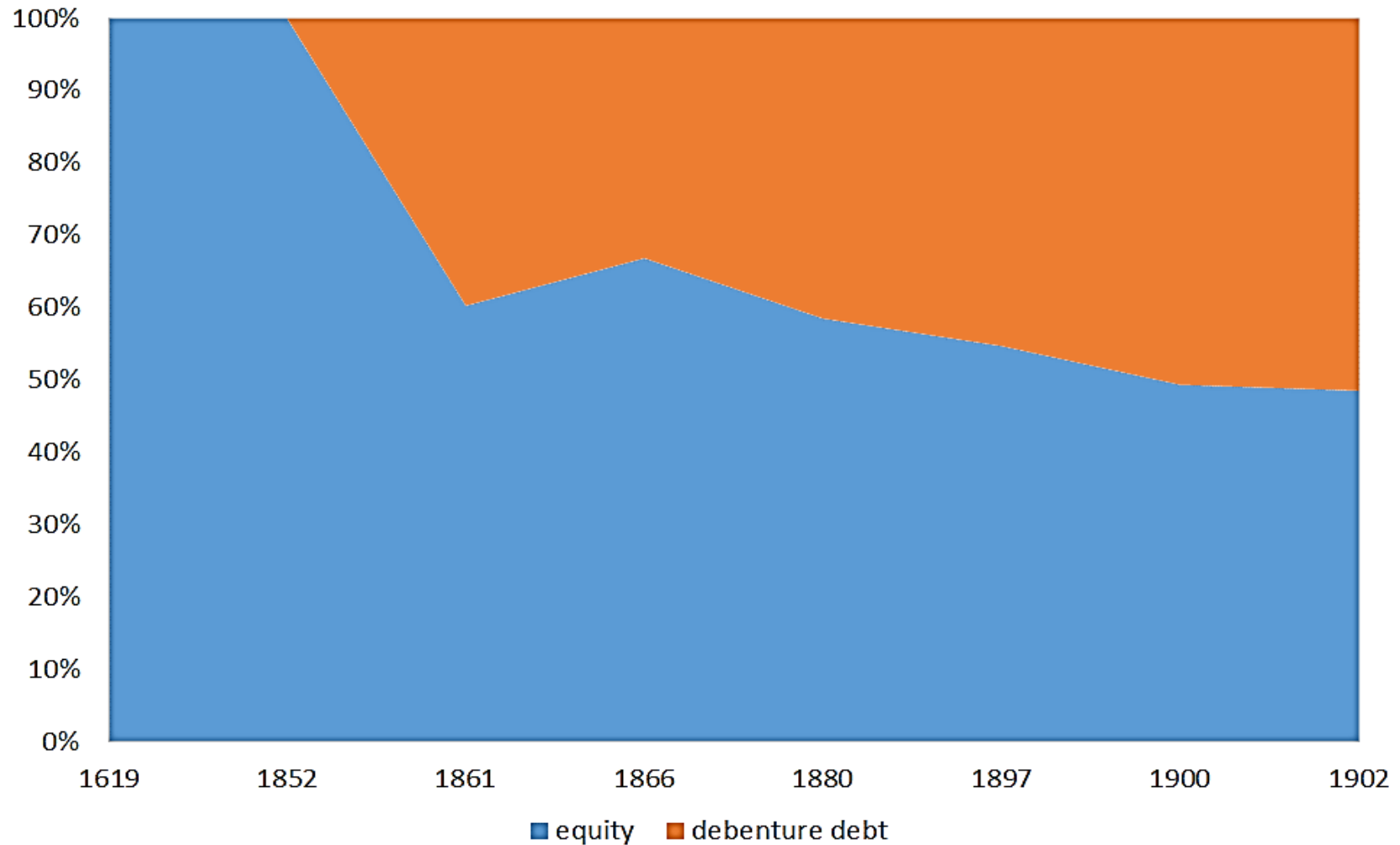
Dividends paid as % nominal ordinary share value



The pink wedge of avoidable costs

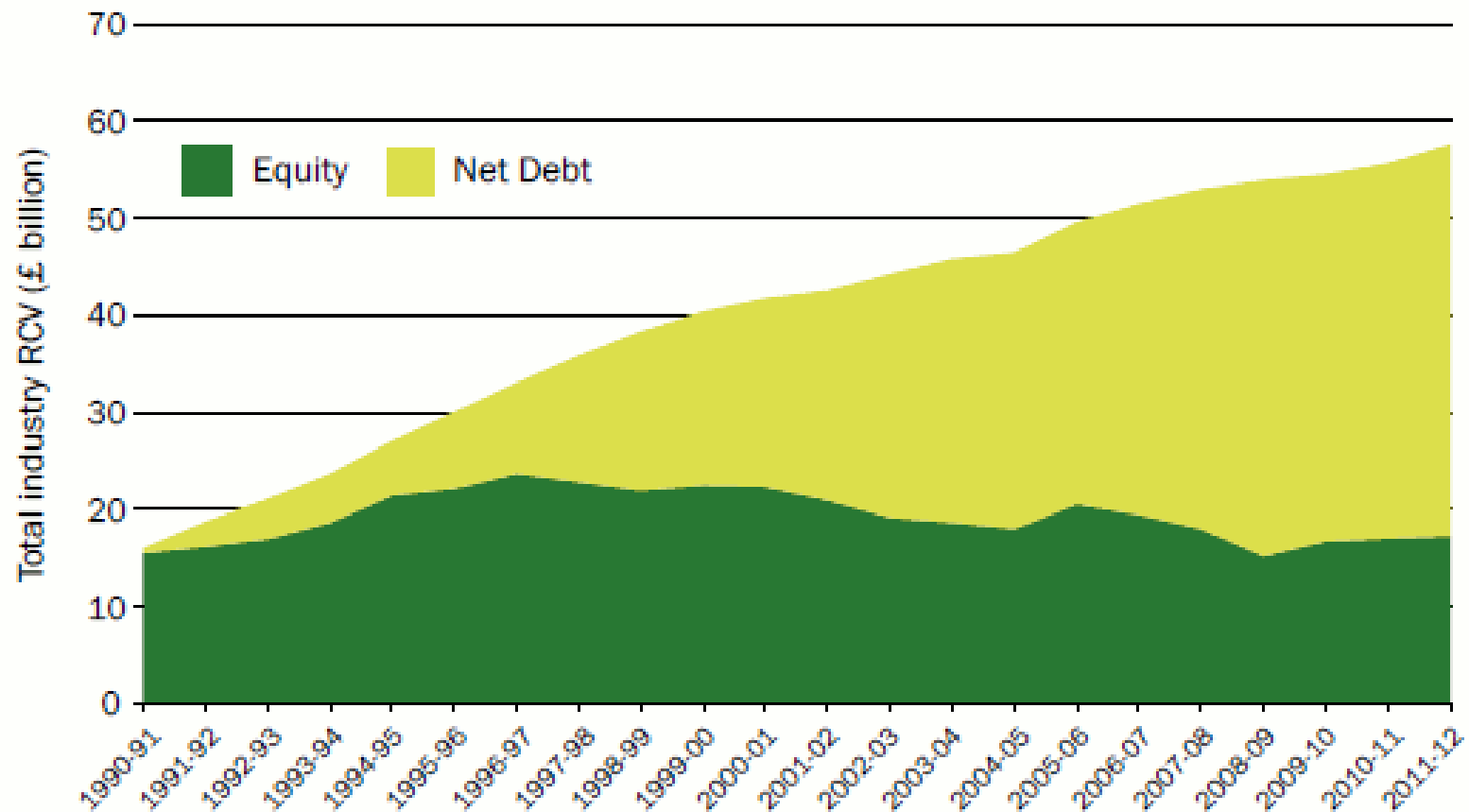


Financial structure New River Company



1989 Water Privatisation via IPO

Gearing at the English and Welsh water companies since privatisation



Source: Ofwat

London's Water Services

Year	<i>Events / Company founded</i>	Finance
100	Roman bucket-and-chain water wheel	Taxes (+ Slavery)
1237	Great Conduit (King + Grants + Bequests)	Grants
1582	London Bridge Waterworks Co. (private)	Equity
1613	New River Company (private)	Equity
1723	Chelsea Waterworks Company (private)	Equity
1904	Remunicipalisation as Metropolitan Water Board	Bonds
1975	Thames Water Authority	Debt
1989	Privatisation – Thames Water PLC	Equity
1990s	Thames Water WASC	Debt
2011	Maquarie Infra Fund purchase	Equity
2012	Chinese Equity Fund purchase	Equity
2015	Thames Tideway Project	PF + Guarantee

FDI in Water Services, 1895

In 1895, 97 water companies (2.5% of LSE total) were listed on the London Stock Exchange – 29 based overseas and 13% multi-utility (water+energy)

Company	Country
Alexandria Water	Egypt
Antwerp Water Works	Netherlands
Cagliari Gas and Water	Italy
Cape Town District Waterworks	South Africa
City of St. Petersburg Water	Russia
Columbo Gas and Water	Sri Lanka
Monte Video Waterworks	Uruguay
Rosario Waterworks	Argentina
Seville Water Works	Spain
Shanghai Waterworks	China

Country	Total
Argentina	1
Brazil	2
Canada	2
Caribbean	1
Chile	1
China	1
Egypt	1
International	1
Italy	1
Lebanon	1
Netherlands	2
Russia	3
South Africa	3
Spain	3
Sri Lanka	1
Uruguay	1
USA	4
Grand Total	29

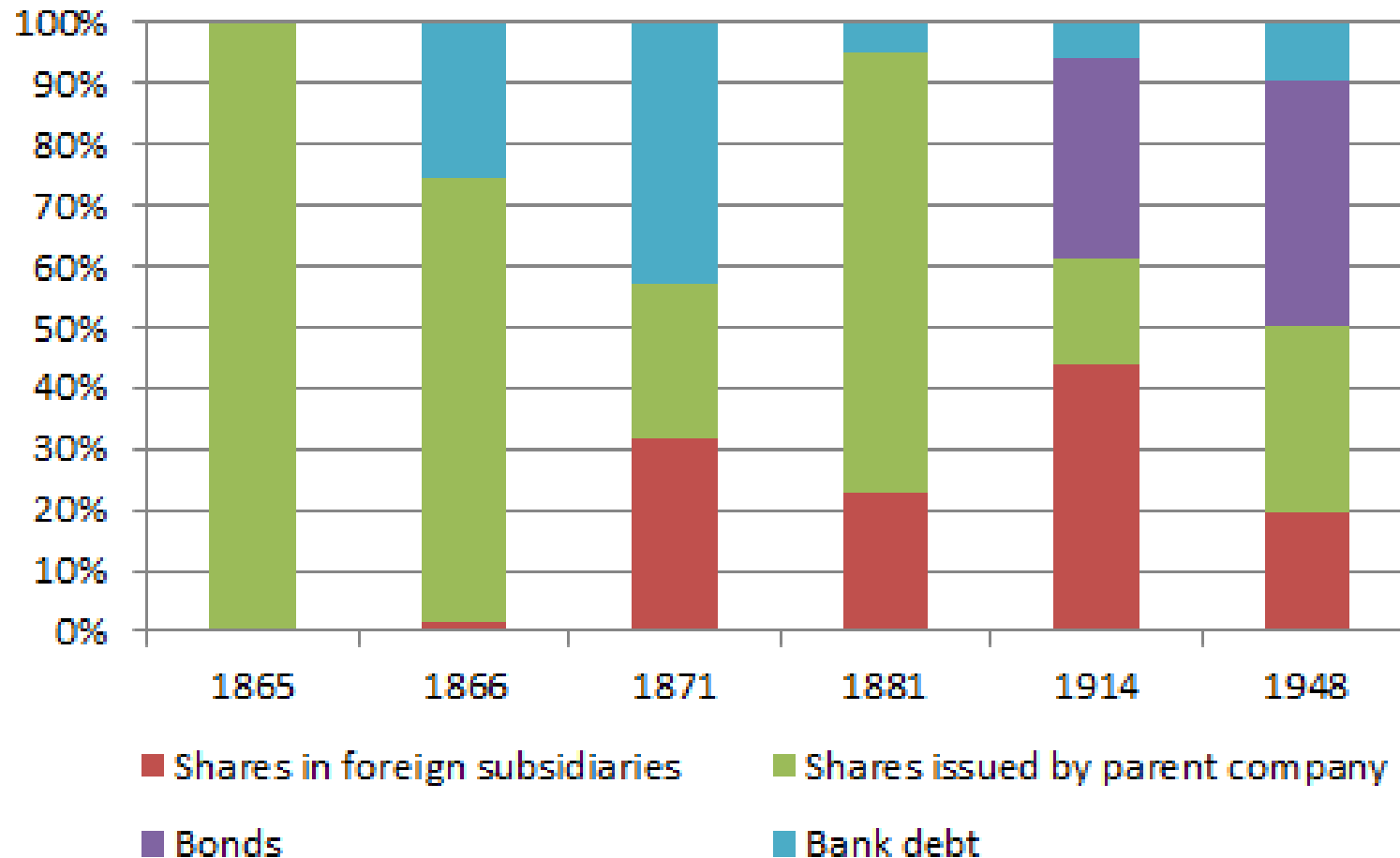
The Largest Water Multinational, 1914

La Compagnie Générale des Conduites d'Eau (CGCE), Liège

Foreign Subsidiaries of CGCE in 1914	Country	Year
Compagnie des Eaux de la Banlieue de Paris	France	1867
Société générale des Eaux de Barcelone	Spain	1867
Société de l'Aqua Pia, Roma	Italy	1867
Compagnie des Eaux d'Utrecht	Netherlands	1882
Compagnie des Eaux d'Arnhem	Netherlands	1883
Societe des Eaux de Santander	Spain	1884
Compagnie canadienne des Conduites d'Eau	Canada	1890
Compagnie d'entreprise de Conduites d'Eau	Italy	1894
Compagnie Générale des Eaux de Vienne	Austria	1895
Eaux de Tilburg	Netherlands	1897
Société roumaine des Conduites d'eau	Romania	1898
Societe hongroise des conduites d'eau (ISTER)	Hungary	1912

Corporate Finance Evolution

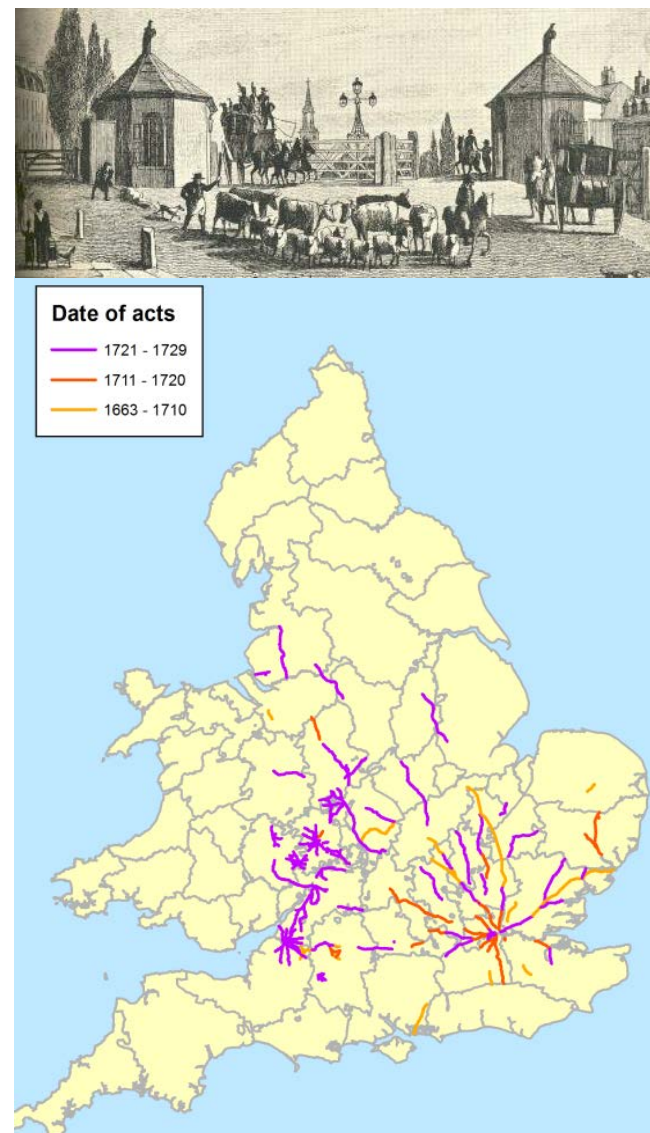
Evolving Capital Structure of CGCE



OTHER SECTORS

UK Turnpike Trusts

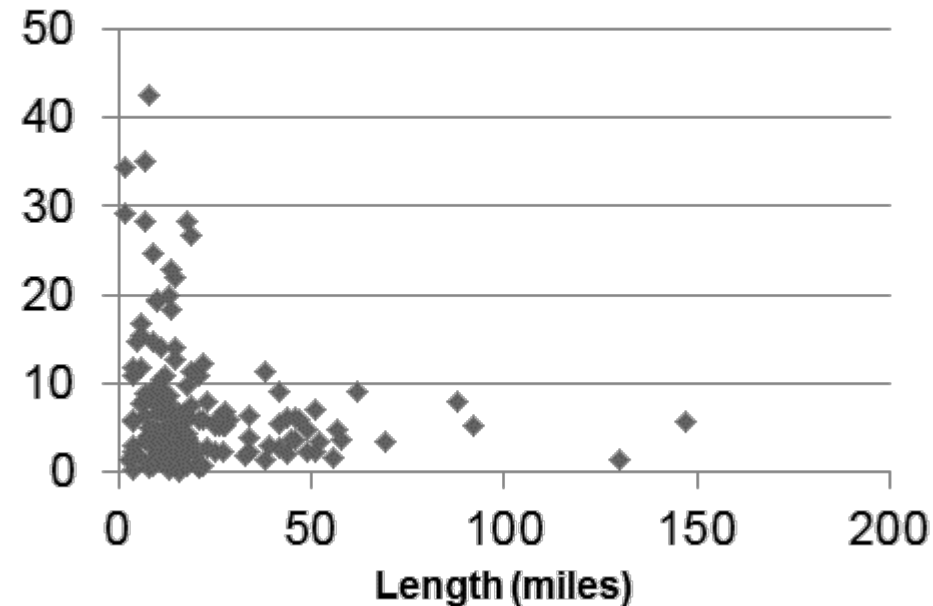
- 1663 Act temporary measure for Great North Road as corvee could not cope
- Charged tolls to users to pay for upgrade and maintenance
- Operated on the existing King's Highway network and legally could not be privately owned - unlike USA, BE, ESP
- Powers for 21 years renewed by Parliamentary Acts
- From 1830 onwards, strong competition from railways
- Most wound up under General Acts between 1873 and 1878.
- 1888 Local Government Act passed road maintenance back to County Councils



Turnpike Trust Finances

- Trustee must own estates yielding at least £100
- At peak around 1300 Trusts, many badly managed
- Tolls set by statute & difficult to change other than on renewal
- Raised debt by mortgaging future toll income
- Bonds & annuities rare
- Toll collection let on contract
- Interest rates typically 4 to 5%
- Few large local investors: local gentry, farmers, merchants, widows, vicars

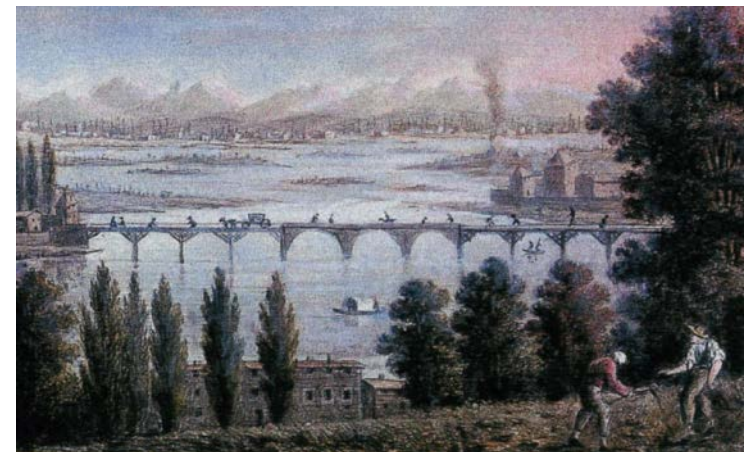
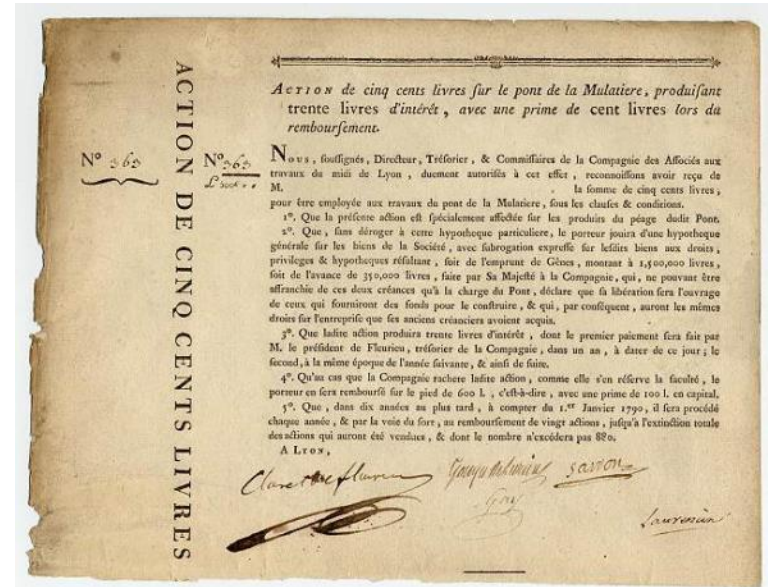
Debt/income in 1824



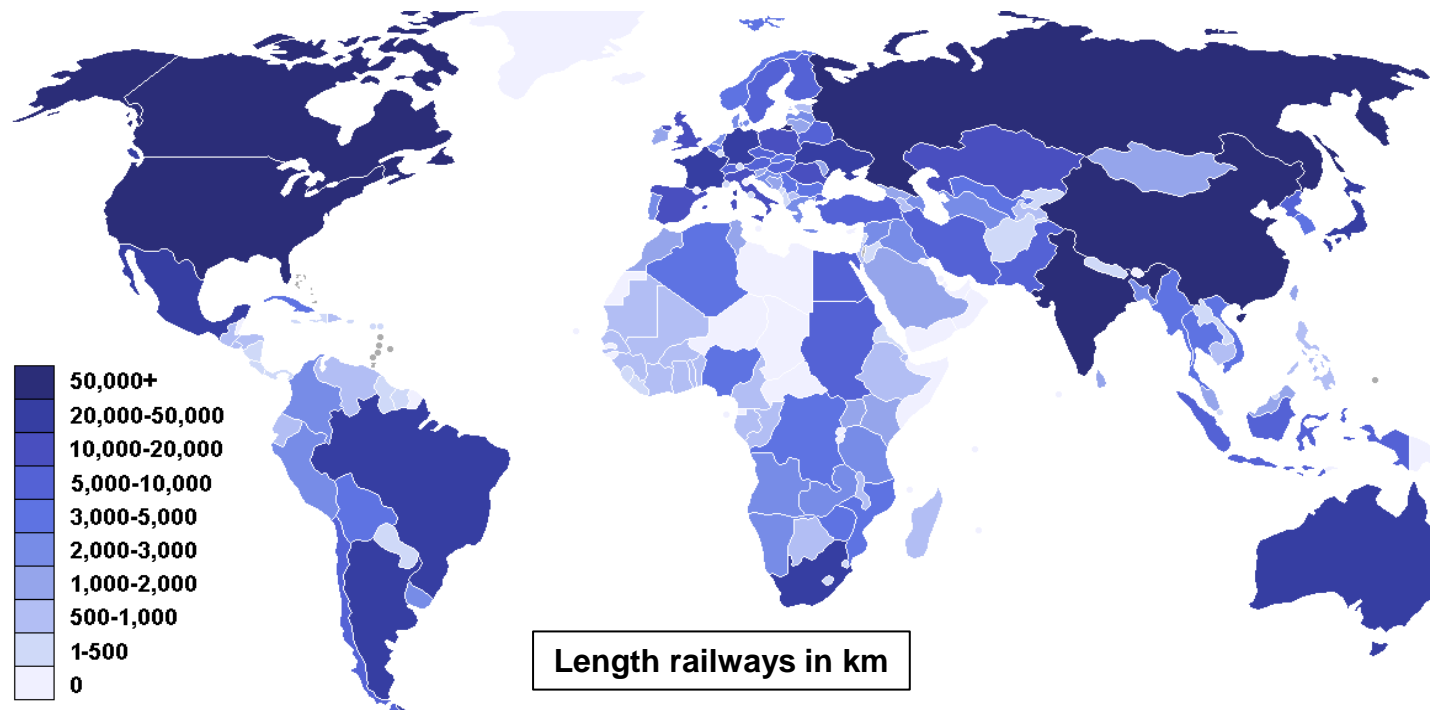
- By 1824, many Trusts hopelessly indebted
- From 1837 to 1849, overall tolls decline 27% due to railways

Le Pont de la Mulatière, 1789

- 1789 Treaty to build a 200m wooden toll bridge over River Saône in Lyon under 99 year concession
- Additional 880 shares (Actions) of 500 livres offering 6% fixed interest plus a 20% premium when shares bought back by the Perrache Co.
- Repayment based on lottery draw
- Claim over other assets of Perrache Company *pari passu* with loans from King and Genoese bankers
- Bridge completed 1792 but damaged by republicans during siege of Lyon
- 1809 State purchases bridge for 500 000 Francs. Rebuilt as mixed road-rail bridge.
- Toll finally removed 1860.



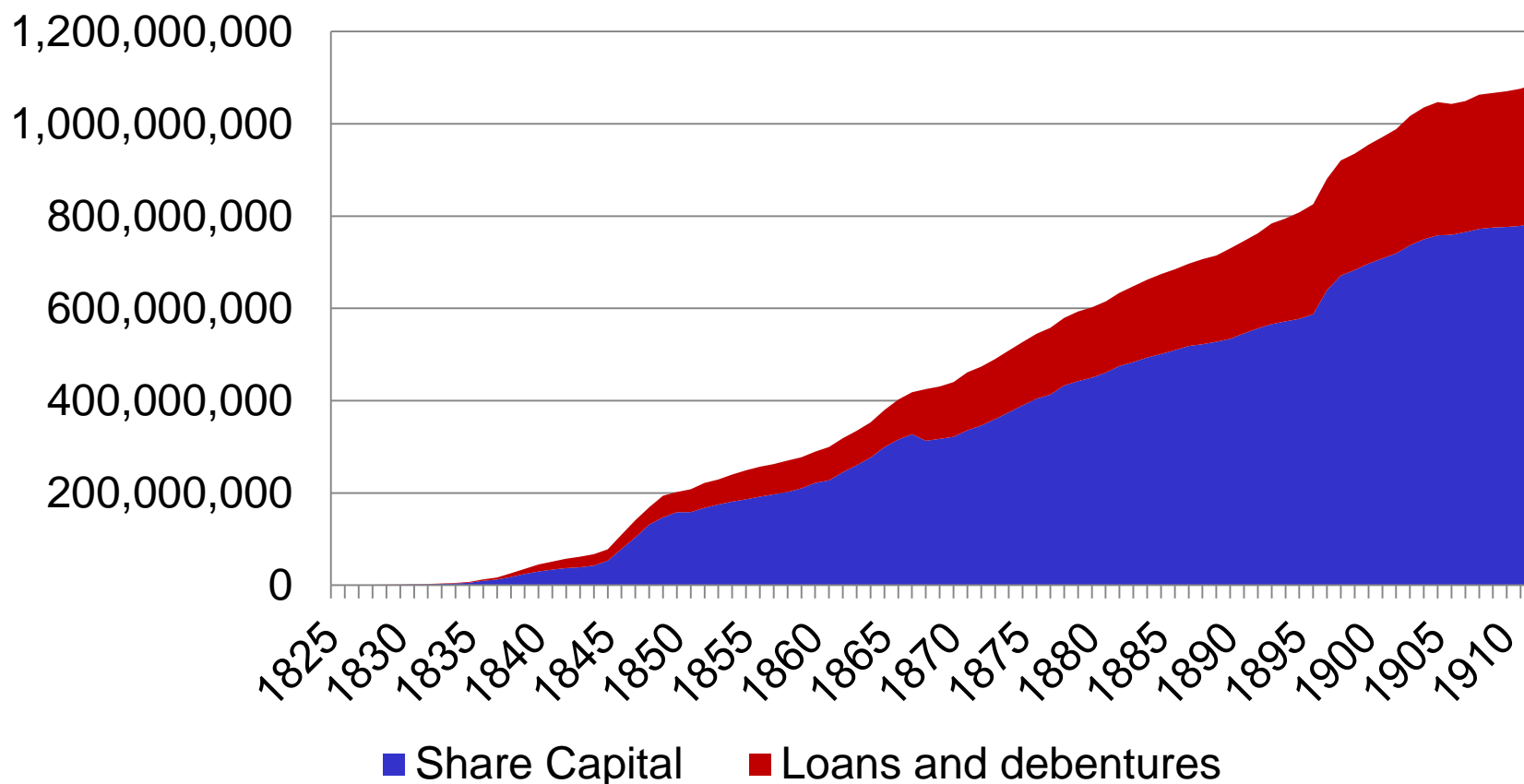
Railways changed everything



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

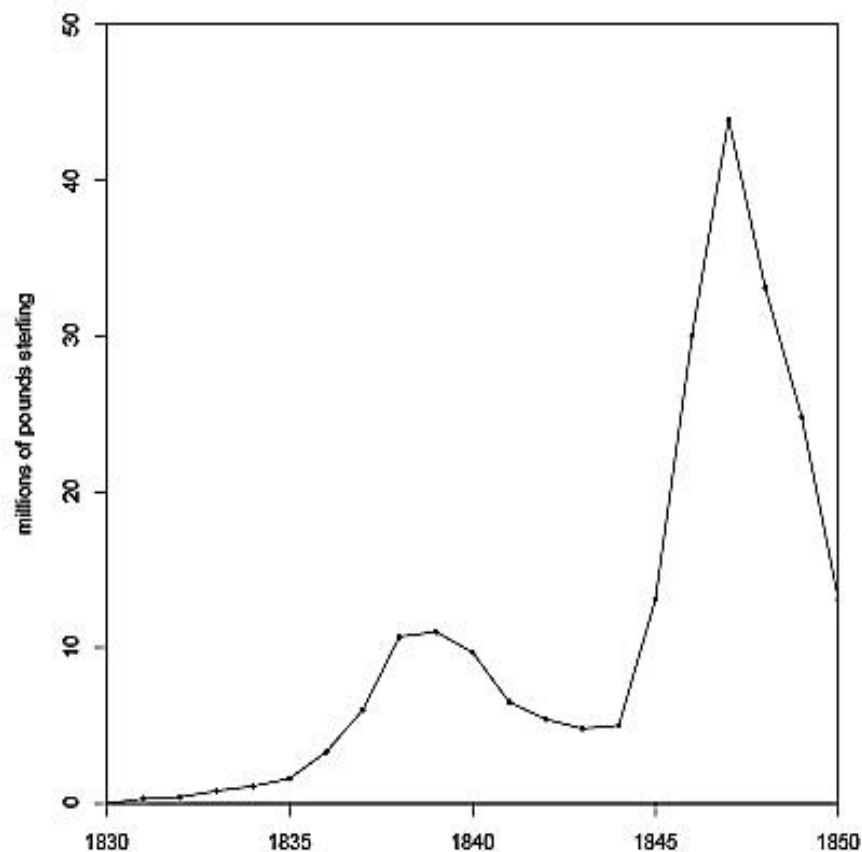
Primarily equity finance for UK railways

England and Wales raised railway capital (£) 1825-1912

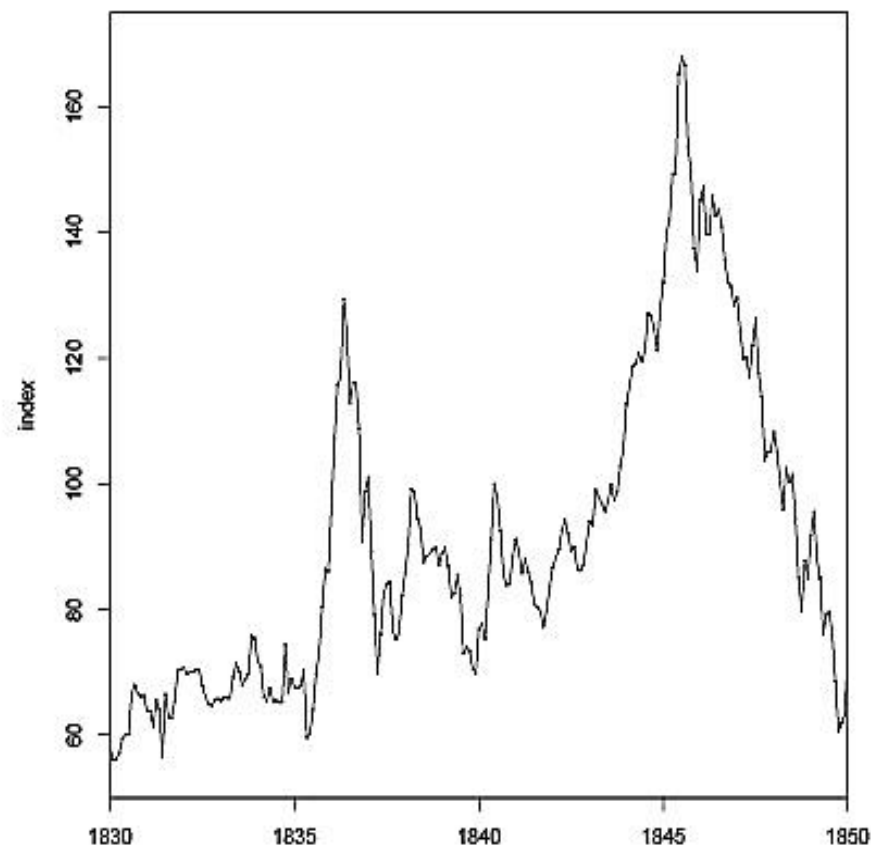


Railway Manias: 1835-38 & 1942-47

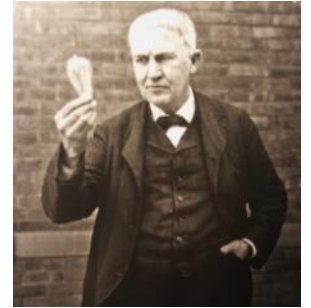
British railway capital investment



Index of British railway share prices



Edison Illuminating Company to Insull Utility Investments, Inc



- 1876 Edison's Menlo Park research lab
- 1879 Edison's patent for an "economic" DC electric generation and lighting system to compete with gas utilities
- 1882 Pearl Street generating station part funded by JP Morgan
- 1880s Edison global patents held by complex web of companies
- 1892 >1000 small lighting utility companies
- Business model: Gain concession and pay for equipment in utility shares
- 1893 Westinghouse develops combined light & power AC system
- 1893 US Financial crash almost bankrupts Edison
- 1895 Niagara Power Project demonstrates long distance transmission
- JP Morgan splits off GE as world's largest electrical equipment manufacturer
- Financially complex/opaque utility holding company structure pushed to limits by Samuel Insull (\$500m controlled by \$27m equity)
- 1932 Insull Bankruptcy

Panama Canal

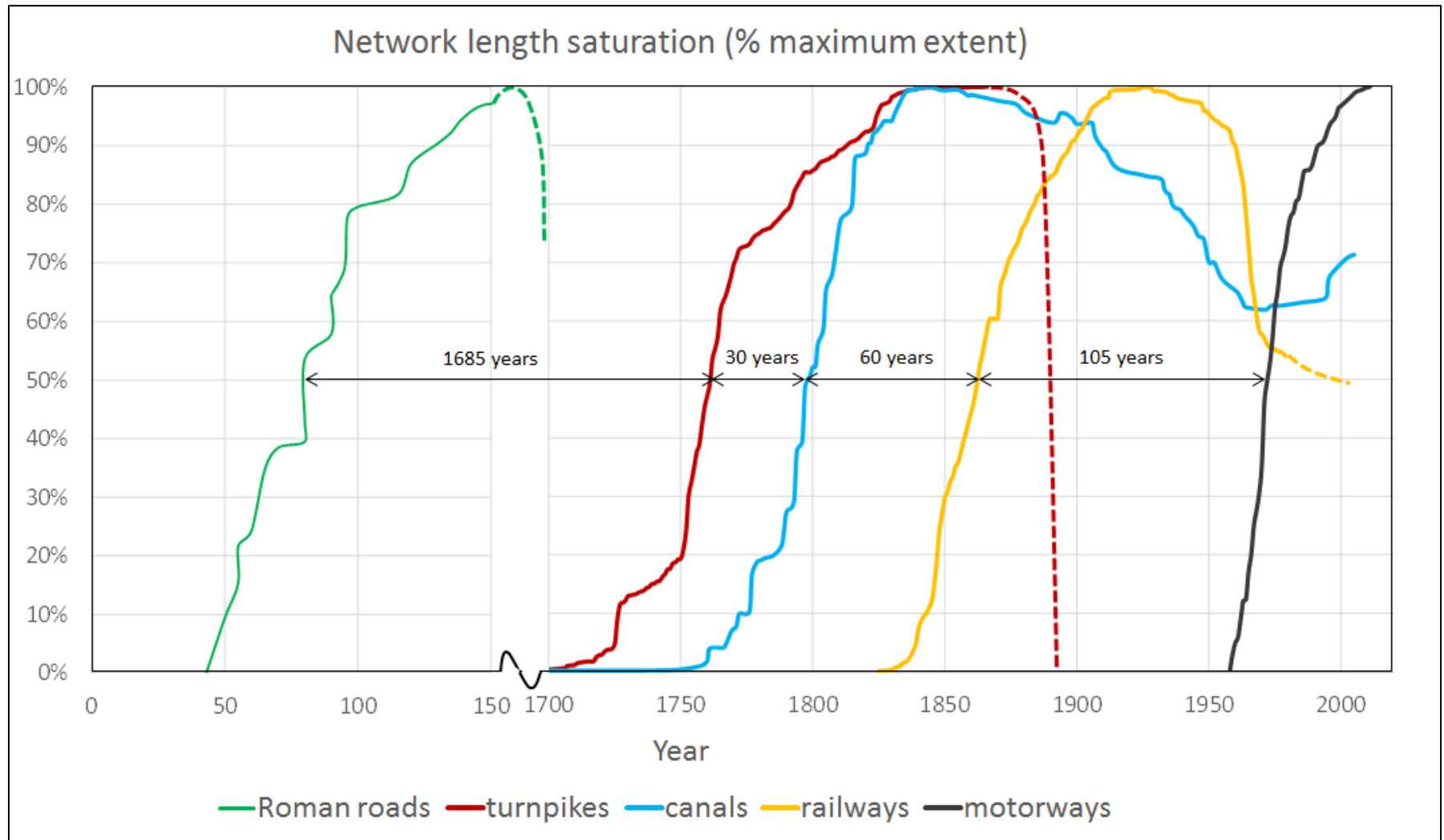
- **1876** - Colombia grants 99-year concession to private syndicate who sell on to Ferdinand de Lesseps (who built Suez canal)
- **1879** – Lesseps forms *Compagnie Universelle du Canal Interocéanique de Panama SA* with 2m francs in founder shares. Then Ordinary shares and debt raised, including lottery bonds.
- Huge technical problems, cost overruns and delays (landslides, 20,000 malaria deaths)
- **1889** – with project 40% complete and 80% debt funded becomes largest corporate bankruptcy in history (\$332m) – political scandal in France
- **1894** - New company (*Compagnie Nouvelle du Canal de Panama*) set up with a capital of 60m francs and opening delayed to 1904. Plan to present a detailed completion plan and cost estimate to new investors. .



- Newly independent Panama grants perpetual sovereign rights over Canal to US Govt which purchases *Compagnie Nouvelle* assets for \$40m as a geo-strategic project
- **1914** - US Govt completes project

BIG PICTURE

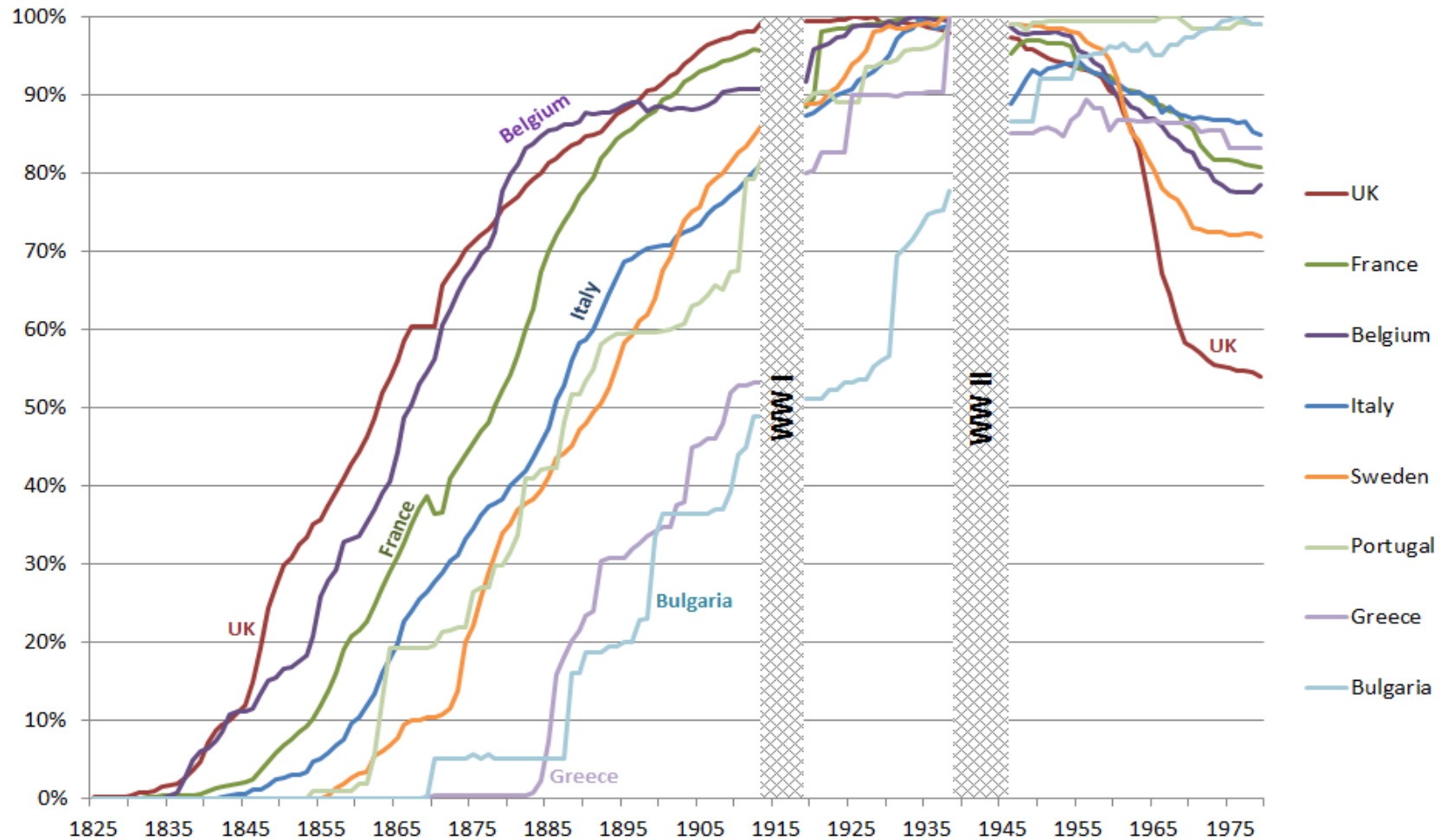
Growth of UK transport networks



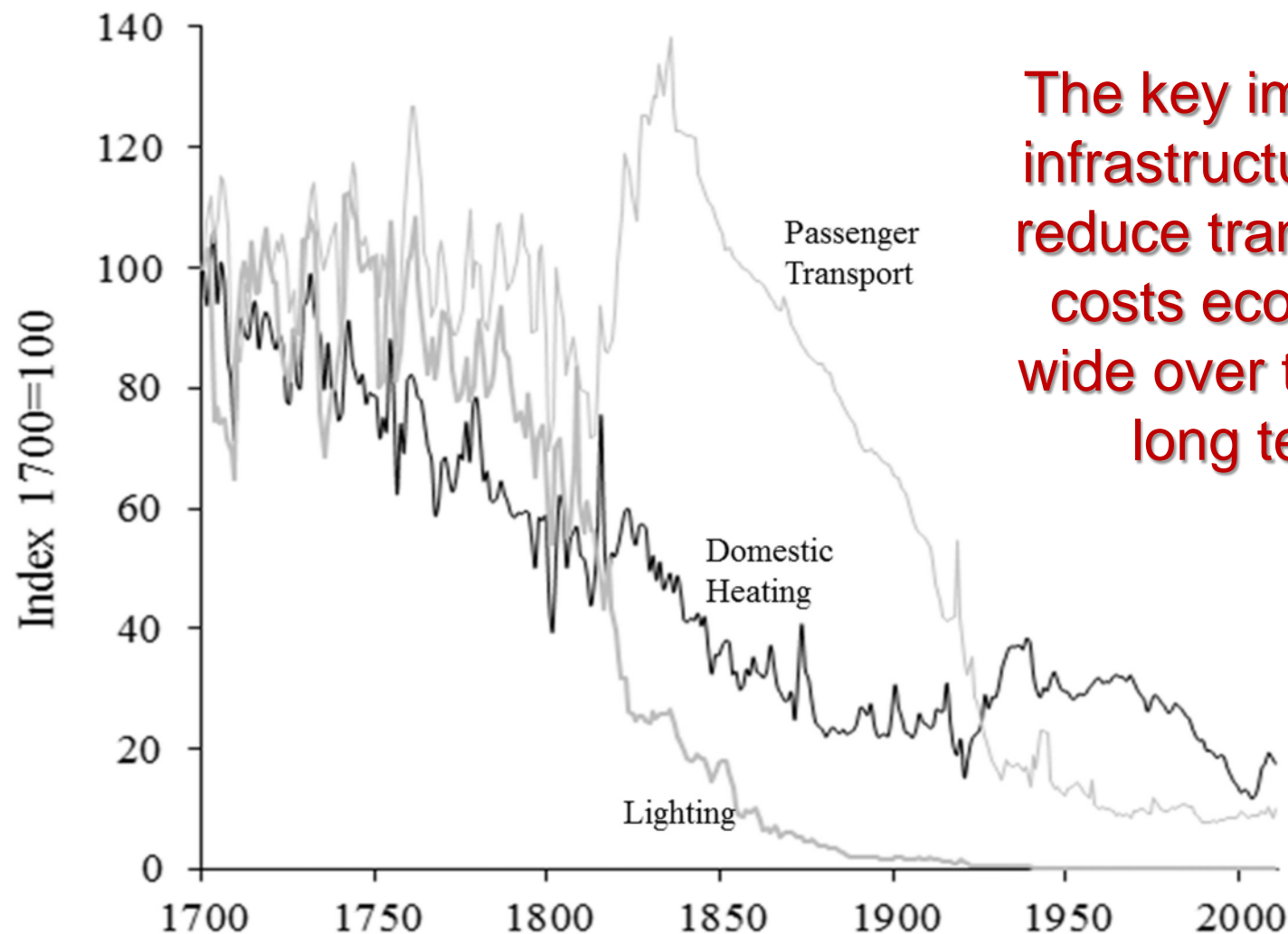
Source: Goldsmith (2014)

Leaders and followers

Railway network (as % maximum extent)

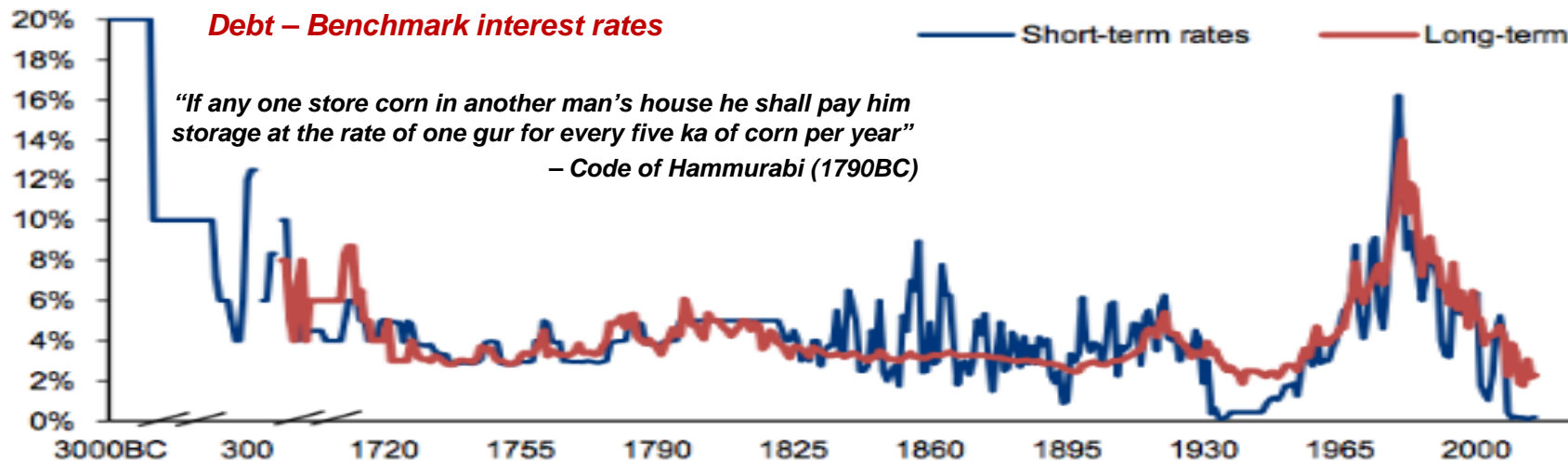


Long run price trends: lighting, heating, transport



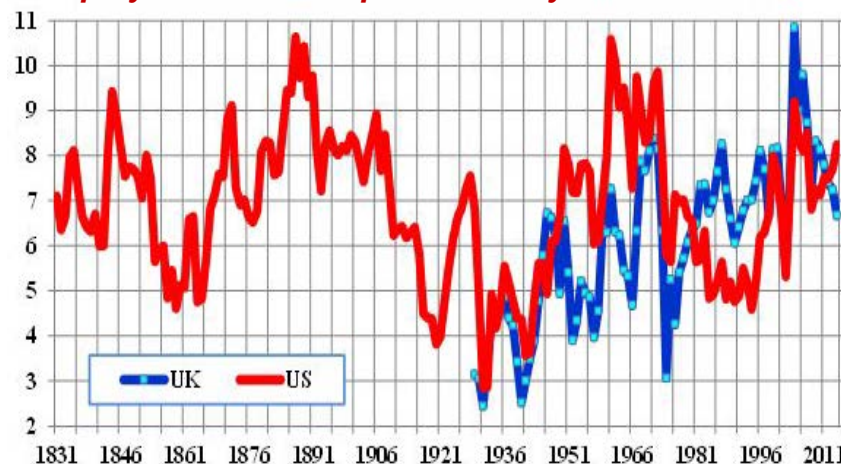
The key impact of infrastructure is to reduce transaction costs economy-wide over the very long term

Long term cost of capital



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

Equity Returns over previous 30 years



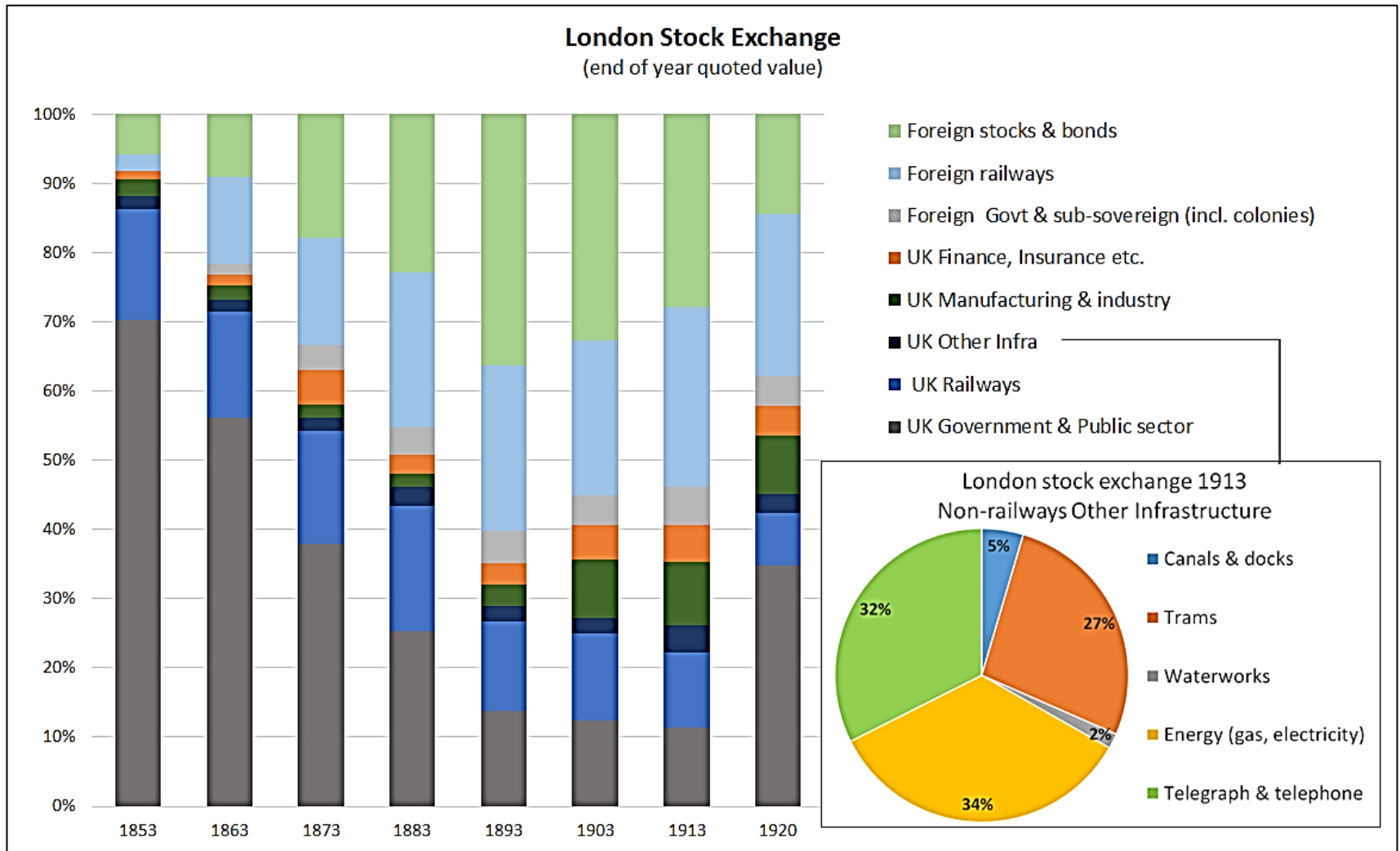
Source: Smithers (2015) - FT

Debt: 3 - 5%

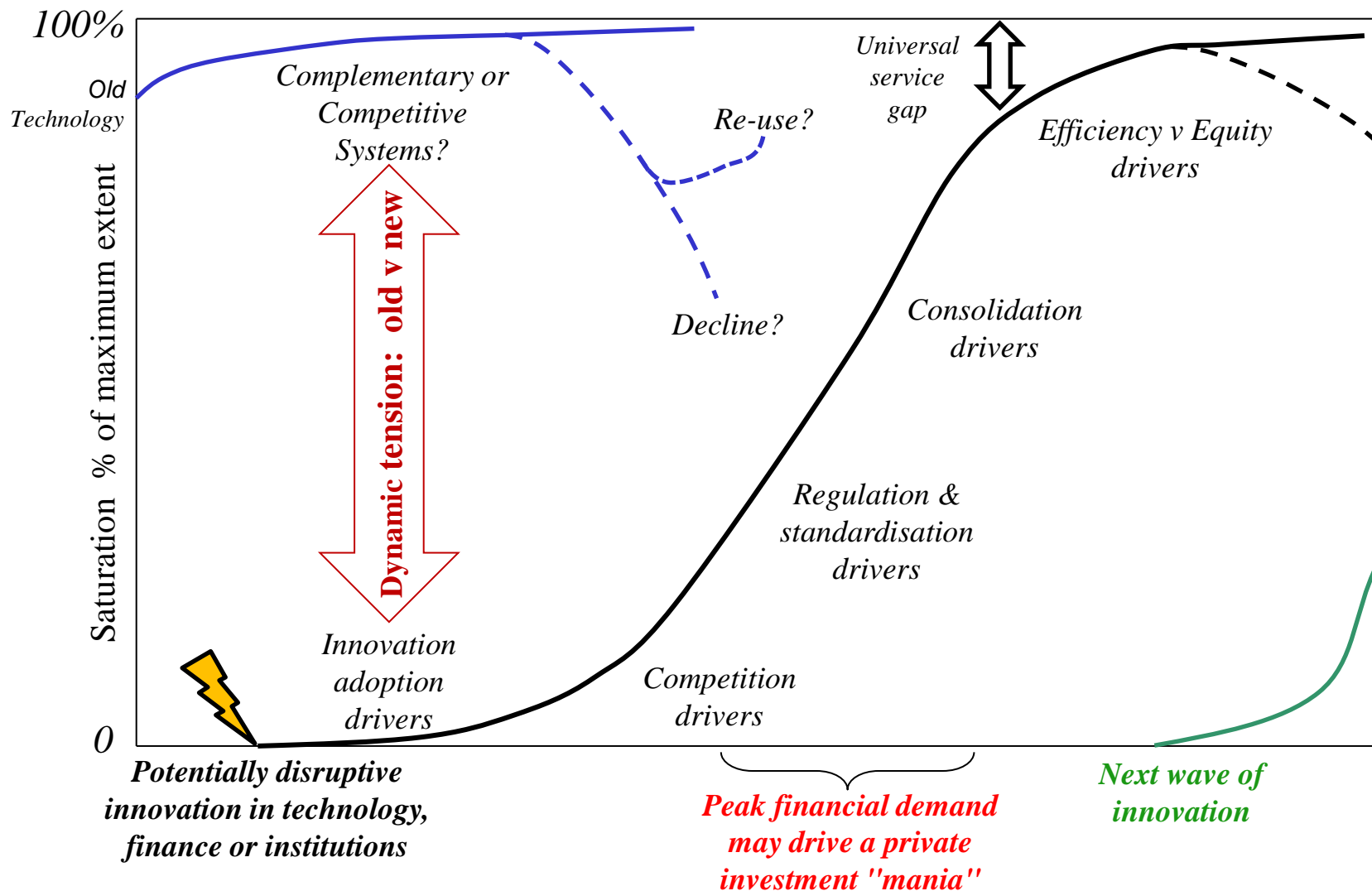
Equity: 5 - 8%

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

Infrastructure - capital market evolution

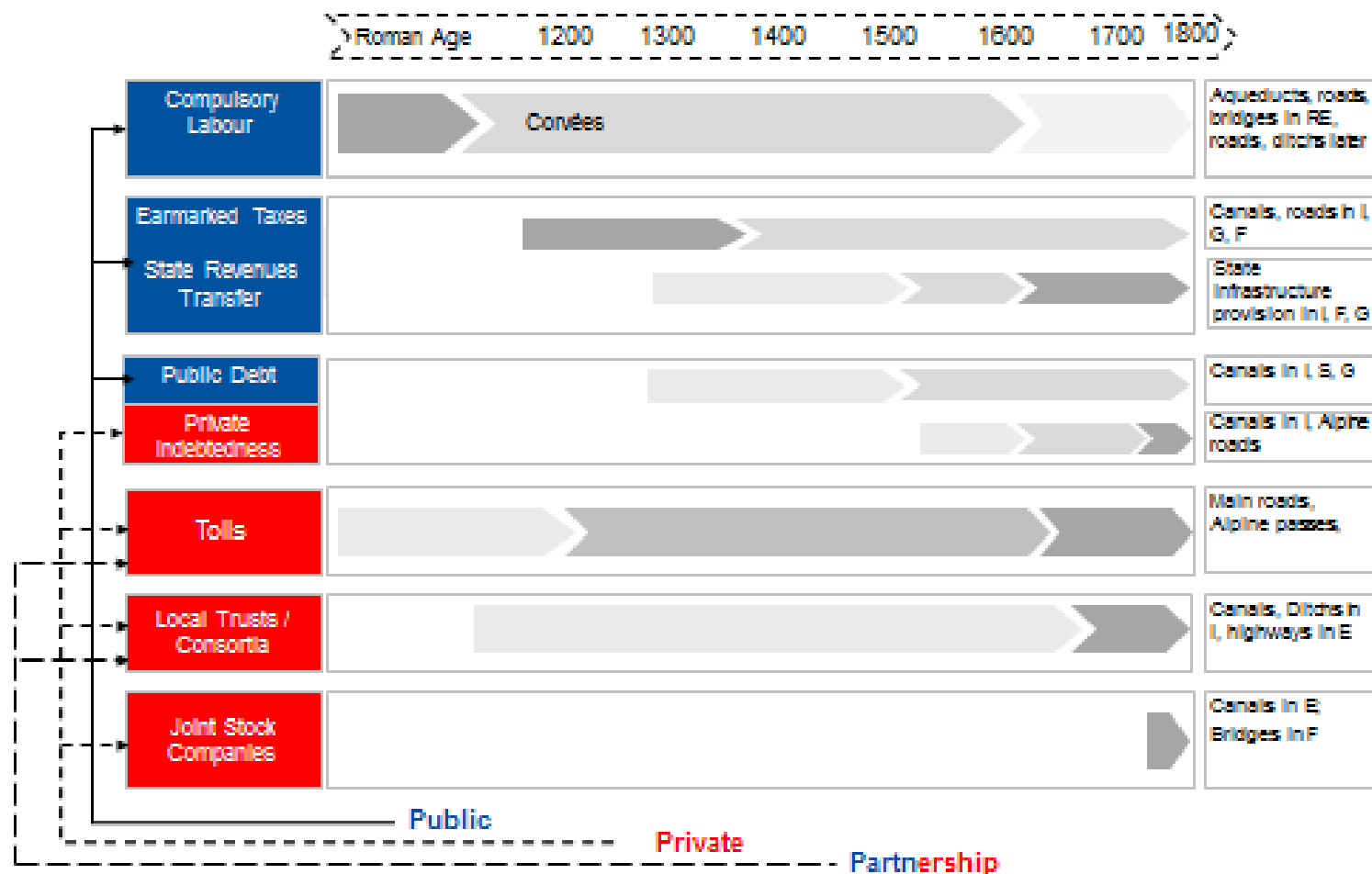


The infrastructure investment cycle



Academic synthesis

Figure 1. Synoptic Table of Typologies of European Infrastructure Finance from the Roman Age to the 18th c.



Synthesis v Themes - Complexity

Infrastructure services evolve to the economic/social environment

- Labour v capital (slavery → 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)

WISDOM



Read some history

Try to learn

Make some mistakes

Learn from your mistakes

Learn from others

Make more mistakes

Write some history

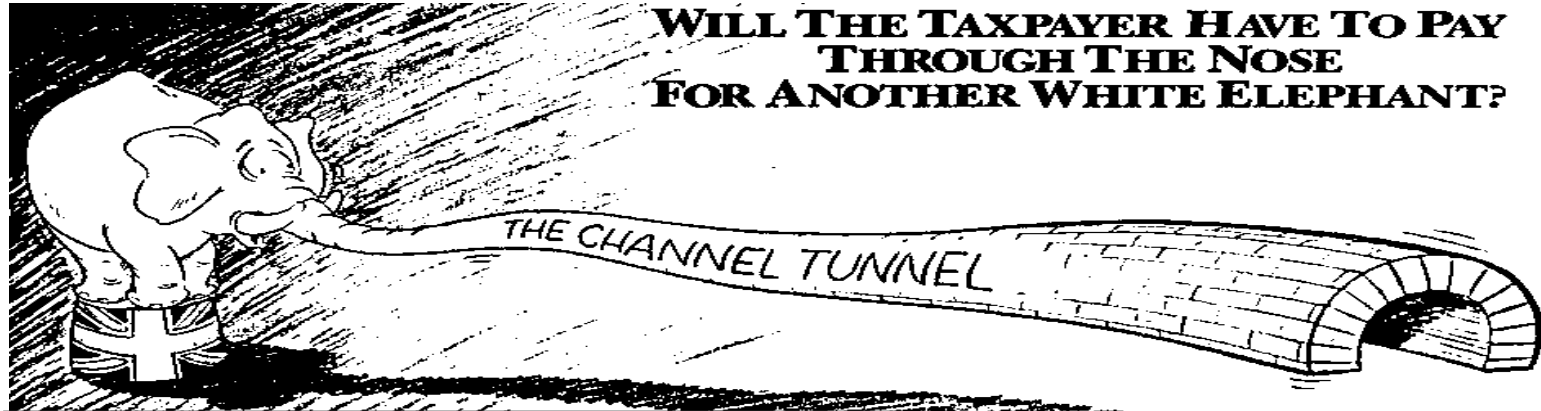
Reference Papers

- Goldsmith, H. (2014). The Long-Run Evolution of Infrastructure Services. CESifo Working Paper Series No. 5073. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2532911
- Goldsmith, H. (2015). Actors and innovations in the evolution of infrastructure services. In Picot, A., Florio M., Grove N., & Kranz J. (eds). The Economics of Infrastructure Provisioning: The Changing Role of the State. MIT press. (pp. 23-91).
- Goldsmith, H. & Carter D. (2015). Financing the Evolution of London's Water Services: 1582 to 1904. DEMM Working Paper 2015-02. <https://ideas.repec.org/p/mil/wpdepa/2015-02.html>
- 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 (pp. 150-190).
- Goldsmith, H. & Boeuf, P. (2015). The Chunnel in History: Breakthrough or Continuity? Paper presented at the Second International Conference: Twenty years under the Channel, and beyond: Capital and governance in major infrastructure projects, Institut français, London, 8 December 2015. <http://ssrn.com/abstract=2717012>

EXTRA SLIDES

EUROTUNNEL

Eurotunnel

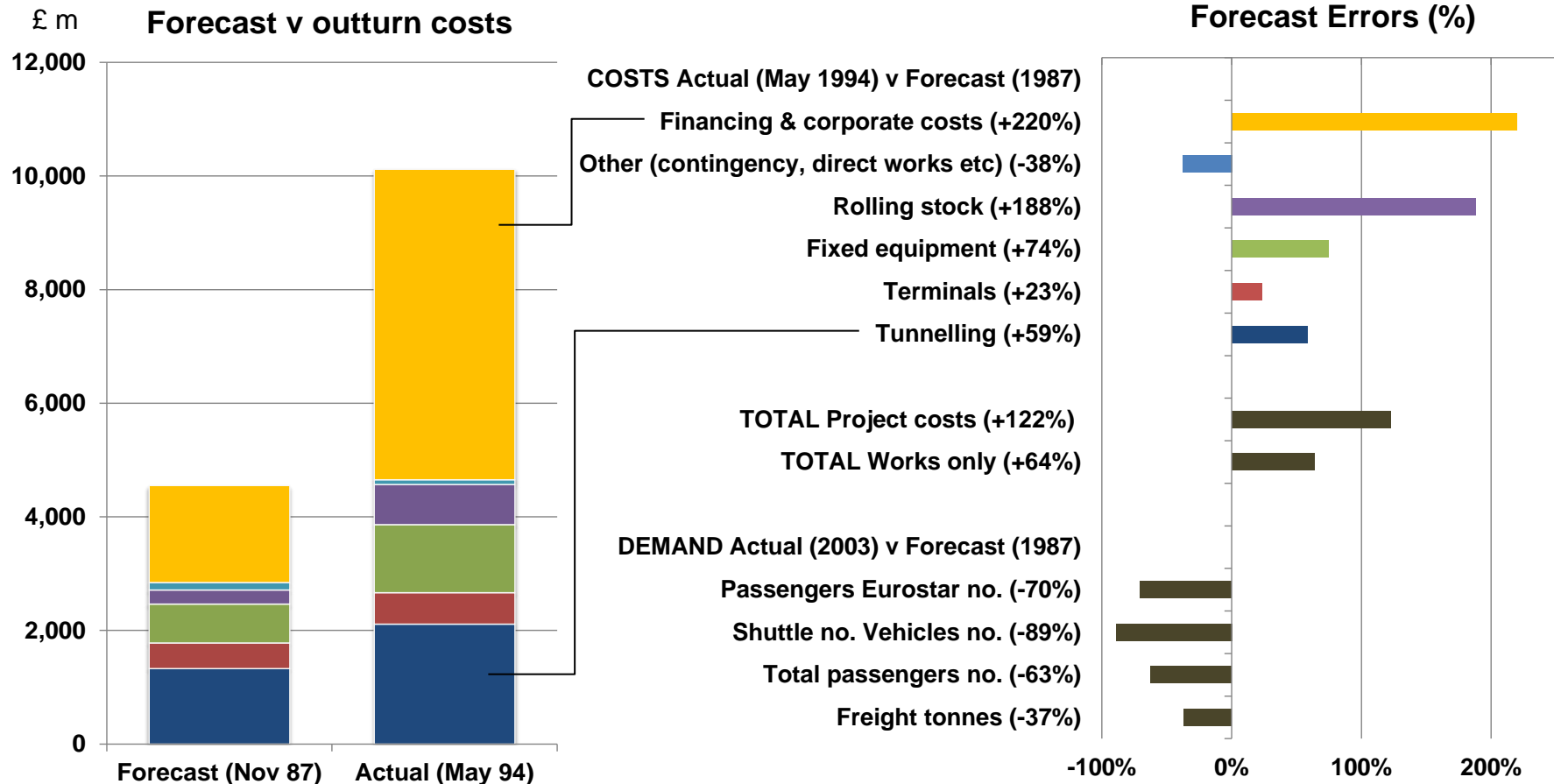


ARTICLE I - Object and Definitions

The High Contracting Parties undertake to permit the construction and operation by private concessionaires (hereinafter referred to as "the Concessionaires ") of a Channel fixed link ... **financed without recourse to government funds or to government guarantees of a financial or commercial nature.**

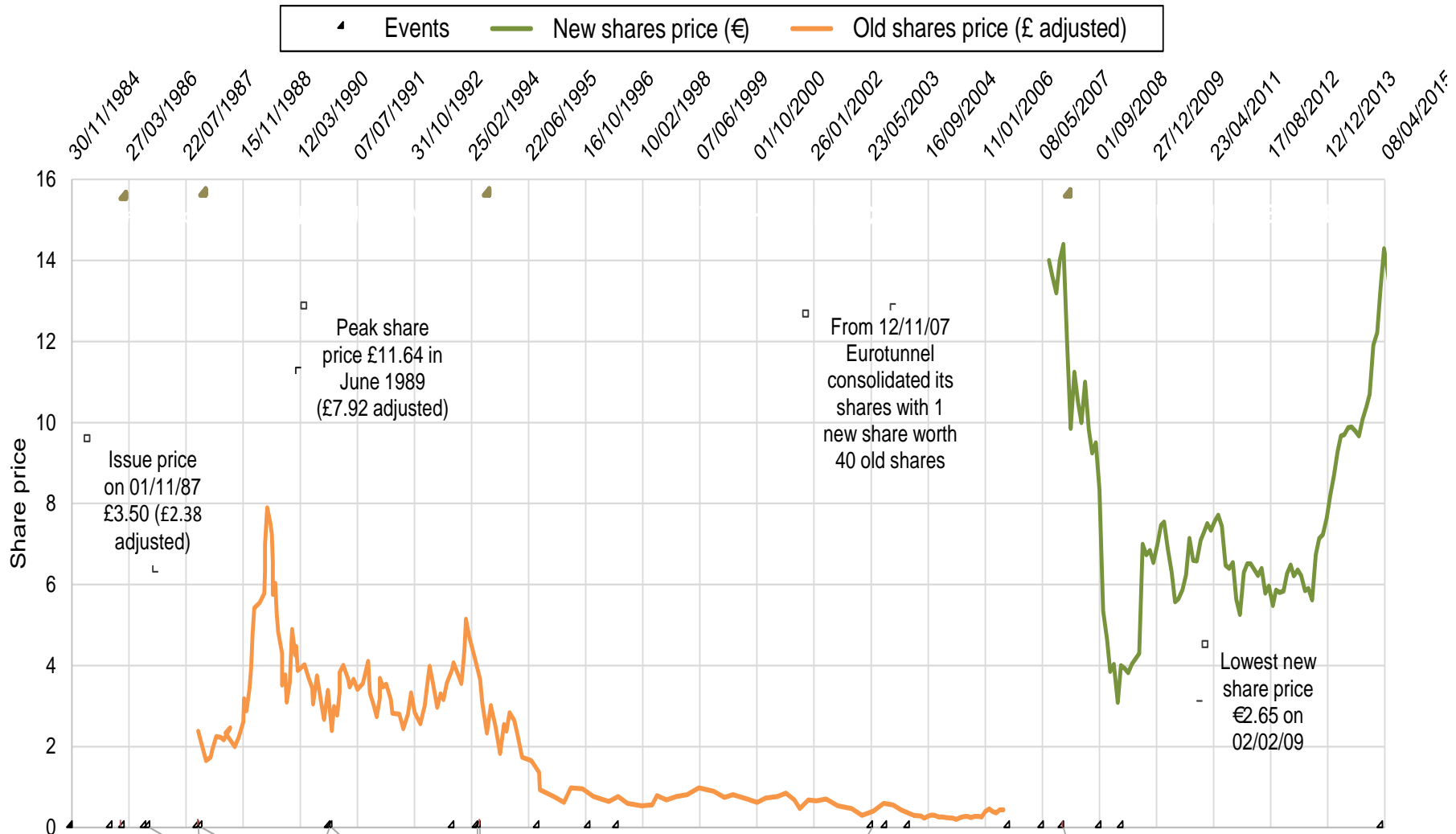


Risks and realities



Cost of private finance - the main risk!

Share price as optimism thermometer



Eurotunnel - Epilogue

- CTRL plans for IPO had to be abandoned as market realized demand risks
- Government needed to provide some guarantees

	Country	Open	Cost (bn £)	Finance
Eurotunnel	UK-France	1994	10.1	Private
HSL connections				
LGV Nord (France)	France	1993	1.9	Public (SNCF)
HSL 1 (Belgium)	Belgium	1997	0.9	Public (SNCB)
CTRL I	UK	2003	1.9	Mixed (PPP)
CTRL II	UK	2007	3.9	
<i>TOTAL</i>			18.7	

- One consequence of Eurotunnel was that market rejected “pure” private finance solutions and looked to government to share risks in Public-Private Partnerships