

# Affordability and Infrastructure Industry Regulation: Lessons from Economic History

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# Key Characteristics of Infrastructure Industries

There are three key characteristics that determine the need for regulation. These are:

- 1) Regulated industries are *highly capital intensive*, with long-lived and often *sunk* assets
  - Implies investors at risk of losing value of assets by governmental/regulatory confiscation or similar
- 2) The industries typically have *considerable economies of scale* and often economies of scope
  - Most obvious with 'unavoidable use' monopoly networks as in railways, electricity & water
- 3) The services supplied are (a) *consumed by and necessary to the welfare of all households*; and (b) *provide critically important inputs for all firms and industries*

[See Levy & Spiller 1994, Stern & Holder 1999]

# The Need for Economic Regulation of Infrastructure Industries

# Infrastructure Industries and Need for Regulation 2002

<b>Industry</b>	<b>Rate of Demand Growth</b>	<b>Rate of Growth of Technical Progress</b>	<b>Potential for Competition  (Including competition in products and competition between networks)</b>	<b>Degree to which Assets are Sunk</b>	<b>Externalities  (including social benefits and relative costs of achieving them)</b>	<b>Overall Importance of Effective Regulation</b>
<b>Electricity</b>	Low	Low	Medium	High	High	****
<b>Natural Gas</b>	Medium	Low	Medium	High	Medium	***
<b>Telecoms</b>	High	Very High	High	Medium	Low	**
<b>Water &amp; Sewerage</b>	Low	Low	Very Low	Very High	Very High	*****
<b>Railways</b>	Very Low	Low	Low	Very High	Medium	*****

# Infrastructure Industries and Need for Regulation 2016

<b>Industry</b>	<b>Rate of Demand Growth</b>	<b>Rate of Growth of Technical Progress</b>	<b>Potential for Competition  (Including competition in products and competition between networks)</b>	<b>Degree to which Assets are Sunk</b>	<b>Externalities  (including social benefits and relative costs of achieving them)</b>	<b>Overall Importance of Effective Regulation</b>
<b>Electricity</b>	Low	Medium	Medium to Low	High	Very High	****(*)
<b>Natural Gas</b>	Low	Low	Medium	High	Medium	****
<b>ICT</b>	High	Very High	High	Medium	Medium to High	****
<b>Water &amp; Sewerage</b>	Low	Low	Very Low	Very High	Very High	*****
<b>Railways</b>	Medium	Low to Medium	Low	Very High	Medium to High	*****

# A Short History of Economic Regulation

# Utility Regulation: Role of Private Sector

In many countries, infrastructure was first developed by private companies

Control was often exercised by municipalities rather than central Government

Water and sewerage, electricity, town gas were municipally regulated and frequently municipally owned

Postal services, telegrammes, telephone services and railways more often national level services

Nationalised state owned enterprises typically a mid-late 20<sup>th</sup> Century phenomenon

# Utility Regulation: Role of Private Sector

- Railways were built by private companies in the 19<sup>th</sup> century UK, much of Europe and America (north and south).
- Electricity distribution and supply companies in UK, much of Europe and US were built by private companies operating municipal franchises, e.g. Thomas Edison in New York
- Municipal ownership of energy distribution, local transport & water common in UK, Scandinavia, Germany, etc
  - Sometimes operating on fully commercialised basis, sometimes semi-commercialised

# Origins of Utility Regulation

Utility service industry regulation developed with the railways.  
(UK public service railways started operating 1825.)

- Step 1: Framework for awarding franchise or similar contracts
  - UK 25 year contracts under 1844 Railways Act
- Step 2: Need for specialist agency to monitor, interpret and enforce contract conditions
  - UK 1873 Railways and Canals Commission
- Step 3: Need for stable means to monitor, review and modify terms of contracts with clear legal process led to development of decision-making regulators
  - For electricity, telecoms etc, achieved in US 1900-35 but not in UK until 1980s privatisations
  - Much more difficult for railways (and sometimes water) because of dependence on subsidy

# Nineteenth-Early Twentieth Century Regulatory Problems in UK

## Key Problems in Nineteenth Century Rail Regulation

- 1) Technical standardisation – railway gauge (interconnection)
- 2) Network interconnection, access, scheduling and charging
- 3) Abuse of monopoly power – lack of information on costs + individualised, unpublished prices -> massive price discrimination
- 4) No price realignment as costs fell from technical progress -> high, monopoly profits, over-investment

Similar problems (especially price – cost realignment) 1875-1920+ town gas, electricity, telephony.

# Regulatory Responses

- US Development of Independent Regulatory Agency Model
  - Regulatory Commissions from around 1920
  - Initially municipal then State Regulatory Commissions
  - Post 1932, evolution of Federal energy, telecom regulatory agencies to regulate inter-State networks and trading
- UK Rail, Electricity Regulatory Agencies but until 1980s without powers to negotiate contract/licence revisions
- State ownership (and regulation by Ministry) always the fallback where economic conditions and regulatory arrangements unable to support commercial operation
  - Often used to consolidate fragmented industries/networks (rail, electricity)
  - Inflation threat to commercial viability without regular price increases

***Effective economic regulation provides an ordered process by which to review and renegotiate regulatory commitments and contracts***

# Infrastructure Industries and the Development of Economic Regulation 1840 -1945

# Affordability and Railway Regulation UK C19

- In UK, canal franchises had been 21-year with fixed tariff but renewable via authorising act of parliament
  - Railway franchises were originally 21 year but soon became indefinite duration => no rate reviews;
  - Result was that prices remained fixed while costs fell from technical progress => sustained high profits of railway companies until 1890s. (After 1890, railway costs stopped falling.)
- UK concerns arose in 1840s over
  - Freight tariffs (millions of them) individually negotiated and not published which led to widespread & abusive price discrimination; and
  - Consumer standards, health and safety and affordability of passenger fares.
- 1844 Railway Act failed to provide effective regulation of freight rates but did introduce USO with affordable passenger services
  - Regulatory running “Parliamentary Train” with Max 3<sup>rd</sup> Class fare of 1 penny per mile;
  - This was much extended in 1883 by the Cheap Trains Act which led to low cost commuting services in London and other major towns.

# Affordability and Railway Regulation UK C19

- New entry in UK railways was very low after 1850 -> revenue sharing, price collusion and mergers.
  - Railway companies vertically integrated into canal and dock companies
  - Major competition problems but no remedial mechanisms.
- Railways and Canal Commission established in 1873 but achieved little because
  - (i) it only considered individual not average rates;
  - (ii) there were no common accounting standards or other informational requirements;
  - (iii) onus of proof on consumers not rail companies
- Onus of proof reversed in 1894 -> ossification of railway rates at time when cost reductions sharply showed and (after 1900) road transport became a major competitor
  - This (with World War 1 impact) set path to nationalisation after 1945.
  - Affordability had become totally dominant relative to efficiency
  - RCC continued as impotent regulator until 1956

# Affordability and Railway Regulation US C19

- In US, price discrimination against shippers (e.g. Mid-Western grain producers) was also the driving force for economic regulation.
  - As in UK, little new entry after 1850 and indefinite franchise contracts with falling costs + captive customers => high prices and railway company profits.
  - 1870-1886 Illinois had a State regulatory agency which imposed price controls and anti-discrimination legislation over freight rates (as did some other Mid-Western States – the Granger States).  
[See Kanazawa & Noll 1994]
- Interstate Commerce Act 1887 removed States' powers over inter-State railways.
  - Interstate Commerce Commission established to prevent illegal rebates and undue discrimination but without price control powers
  - 1906 Hepburn Act allowed ICC to set maximum prices – which it did until 1970s
- Passenger railway affordability much less of an issue in US with commuter rail services regulated (and often owned) by municipality or State – with major political involvement and pressures for 'fairness'.

# Telecoms and Affordability 1890 -1990

- The important affordability issue for telecoms was *having access* to a telephone, not *owning* a phone or line.
- US main affordability issue was rural telecoms
  - In 1913 AT&T given responsibility to develop a network with “reasonable prices of service”;
  - Regulation was initially handled by State Regulatory Commissions then by FCC and State Commissions
  - 1934 Federal Communications Act (& FCC) prescribed the need to make *an affordable basic telephone service available to all*;
  - Universal Service Fund established to enable long-distance carriers to cross-subsidise low income households and high cost areas;
  - System continues and in 2016 USO was extended to lifeline subsidy to internet access

# Telecoms and Affordability 1890 -1990

Price (and affordability) regulation not a priority until home ownership of landline phones was 70-80% plus.

- US telecom penetration around 40% in 1940, 78% in 1960, 90% in 1970
  - UK telecom penetration only 35% in 1970, 72% in 1980, 90% by 1990
- Phone networks established for business purposes. Hence, strong economic incentive to increase domestic phone use and ownership
    - (a) off-peak (weekends and evenings); and
    - (b) while network capacity was scarce and strong network externalities were present (so long as  $p > SRMC$ )
  - Resulting solution was monopoly with extensive pattern of cross-subsidies
    - Calls subsidising household rentals
    - International calls subsidising national calls & long-distance subsidising local calls
    - Business calls subsidising domestic calls.

*This model very common across OECD countries until 1980s  
MANY OF ITS FEATURES TRANSFERRED TO ELECTRICITY*

# UK Electricity 1880 -1945

- Electricity originally used in 1880s for lighting (replacing gas) and then for urban tramways and, after 1900, for industry
  - Share of industrial use largest element by 1909 and 51% in 1913
- Industry developed on basis of vertically integrated municipal generation (G) + distribution (D) and Supply (S)
  - Areas with industry would build out D to local housing
  - Little regional operation or interconnection pre-1945 outside North-East (NESCo)
- Electricity companies operated with franchise contract that set the price for the duration of the franchise (21 years 1882-88 then 42 years)
- Municipalities had right to buy out franchises after 21 years at written-down value of capital
  - Result: By 1900, 72% of electricity enterprises were municipally owned, including 44 out of 50 largest towns.
  - Municipal ownership of smaller G + D&S until after 1945

# UK Electricity 1880 -1945

- Electricity to domestic customers spread relatively slowly from rich (1880s lighting) to middle class customers and in 1930s to more prosperous working class customers
  - By 1939, around 65% of homes had electric service but:
- Pre-1939, many homes with just lighting service, some with just 1 plug socket and only a small % with a set of sockets
  - 77% had electric irons, but under 40% had vacuum cleaners.
  - Heating was still mainly by coal but 27% households has electric fires by 1939
  - 1.1 million dwellings served by DC in 1937-8

[See Hannah 1979]
- UK roll-out around 10-20 years behind US – particularly on central heating, refrigerators and washing machines.

# UK Electricity 1880 -1945

- No obvious UK affordability problem pre-1945 because:
  - (i) Continuous cost reductions from technical progress, improved load factors and growing demand;
  - (ii) Incentives to expand demand – particularly for off-peak evening consumption
  - (iii) Low Public Works Board interest rates supporting investment.
- Fouquet's evidence on UK energy elasticities suggests electricity only became a 'necessity' by around 1950
  - By 1950, household income elasticities for heating and lighting had fallen to around 1.0 from  $>2.0$  in C19
  - By 1950, household price elasticities had fallen to around -0.5 from -1.5 for lighting (in 1870s) and for heating (in 1920s).

# US Electricity 1880 -1945

- Roll-out of electricity to households much faster in US (at least in urban areas)
  - By 1940, 79% of homes had electric lighting with close to 100% in towns. The price of electric lighting fell 79% between 1902-29.
  - By 1940, 40% of US households had a refrigerator and/or washing machine, 80% had a radio, electric iron and washing machine. [See Gordon 2016]
- As in UK, from before 1900, service was provided under municipal franchise contracts
  - By 1900, these had become 20-50 year franchises for vertically integrated companies with retail prices specified in nominal \$.
  - There were no reversion/buy-out rights as in UK

# US Electricity 1880 -1945

- Given cost-reducing technical progress and capacity expansion needs, contract revision procedures became increasingly important
  - By 1920, there were 36 State Public Utility Commissions which developed classic US rate of return regulation
  - FPC (Federal Power Commission) inaugurated 1920 and was given price regulation powers for electricity in 1935 (e.g. for transmission).
- Growth of rate of return regulation reflected affordability pressures
  - Development of codified regulatory framework setting out rights of companies, investors and regulators over 1910-40 period (Hope Natural Gas Case 1944).
- Regional Developments including large hydro dams reduced costs to regions
  - Rise of lifeline tariffs a major response to bringing electricity to low income households

Competition, Natural Monopoly,  
Efficiency and Affordability in the  
Writings by Economists on  
Infrastructure Industry Regulation

# Competition and Natural Monopoly

It has been common to think of electricity, telecoms, railway etc industries as vertically and horizontally integrated “natural monopolies” – sometimes municipal/regional; sometimes national.

***This is mistaken for the following reasons.***

- (i) The industries all started as competitive industries supplying industry and high income urban households;
  - The late nineteenth century saw short-lived competing town gas supply and distribution companies in London (Turvey) and electricity franchises in the US (Kahn);
- (ii) Consolidation and natural monopoly arose because the scale of electricity companies was small and their efficiency low. Also, competition drove down the quality of electricity supply.
  - Network economies of scale and externalities were major driver factors.
  - The growth in the optimal scale of plant, rising investment costs and the need to serve customers on demand were also crucial

# Competition and Natural Monopoly

- Modern economic thinking about “natural monopoly” is focused on costs and, in particular, whether or not marginal costs (usually LRMC) is continuously declining over the scale of market.
  - Marginal cost theory was only developed from 1870s and '80s
  - LRMC thinking for infrastructure industries was only seriously developed after 1945 (Boiteux, Turvey) and only seriously applied in policy and regulation from the late 1950s
- In electricity, it was very hard to unbundle electricity and telecom companies between monopoly networks and competitive service markets until computerisation had developed sufficiently – the 1970s
  - Telco unbundling from 1982 (AT&T) and later in UK
  - For electricity, PURPA was enacted in US in 1978.
- The doctrine of “natural monopoly” also provided an intellectual basis for cross-subsidies to ensure affordability for household customers
- Efficiency and affordability not in conflict so long as market expansion continued to reduce costs (as seemed to be the case for telecoms & electricity in UK in 1930s)

# Post-1970 Regulatory Discussions on Efficiency and Distributional Issues

- By late 1960s and early 1970s, commentators and economists expressed increasing concerns about cost efficiency and productivity trends in electricity and other nationalised infrastructure industries (viz. Richard Pryke)
  - First response was to develop MC-pricing within the nationalised industries like CEGB (and similar in France, US regulated industries)
- But, attention increasingly turned to introducing competition in both telecoms and energy.
  - Initially wholesale competition and for industrial consumers;
  - Increased efficiency main objective;
  - Major trend in later 1970s across OECD.
- Retail competition for residential consumers not on agenda not least for price rebalancing and consequential price rebalancing reasons.
  - Retail competition in both fixed line telecoms and energy required extensive price rebalancing
  - For telecoms, retail competition only seriously developed from explosive mobile growth post-1993.

# Post-1970 Regulatory Discussions on Efficiency and Distributional Issues

- 1960s & '70s reforms raised the question of whether price rebalancing as indicated by LRMC (and even more competitive markets) would raise major political and economic concerns for lower income, elderly and similar households
  - A standard economics textbook answer has been to say that this is an issue for the social security and tax system ...
  - But, this has never happened – and looks to be totally impossible in a world of sharply fluctuating fossil fuel prices.
- In UK, efficiency gains from privatisation meant that regulators and governments avoided having to confront the trade-offs until after 2005
- The squeeze on living standards post 2008 from the Great Recession enormously increased affordability pressures
  - Affordability problem in practice relates to 3<sup>rd</sup> quartile and below of income distribution (including moderately low paid) not just households in poverty
  - Much worse for energy because rise in fossil fuel prices.
  - Muted for ICT because sustained cost reducing technical progress plus income elastic new products (Mainly a rural and 'not-spot' problem)

# Post-1970 Regulatory Economic Thinking on Efficiency and Distributional Issues

Modern economic textbooks from Kahn (1970) to Decker (2015) emphasise the core role of regulation in maximising efficiency (productive, allocative and dynamic) and that affordability issues should be left to others

But, in practice, regulators do not do this:

“... many, including economists, would concede that, in practice, regulators, politicians and the courts do consider issues of fairness and distributive equity in applying regulatory policy” (Decker 2015, p.21).

***A major reason why regulators do not (and cannot) ignore affordability and distributional issues is that, when affordability pressures rise sufficiently, governments change mandated regulatory priorities – or impose their own rules via policy action.***

***Governments are both rule makers as well as players in the repeat regulation game. This is the key lesson from the economic history of infrastructure industry regulation.***

# UK Utility ICT Regulation 1985 – 2000

# ICT Usage in UK since 2000

- Telecom regulation has become ICT regulation (Information and Communications Technology) as internet access and broadband use has grown enormously.
- Mobile ubiquity has dissolved distinction between telecom ownership and telecom access
  - In UK there were still 155,000 payphones in 1999 – 97K BT kiosks and 58K located on private property (hospitals, pubs, etc);
  - Mobile killed off payphones: BT callbox revenue fell by 40% 1999-2001 and by 2016, there were only 47K remaining BT kiosks, with many used less than once per week.
- Rise of internet and broadband (fixed and mobile) means ICT has effectively become an essential commodity for households as well as businesses
  - In 2015, 86% of households had an internet connection as against 57% in 2006 – and under 10% before 2000.
  - In 2015, 66% of adults had a smartphone – up from Zero before 2009.

# ICT and Affordability in UK since 2005

- Competition is dominant mode of supply for ICT but Ofcom clear that regulation is crucial for effective competition and consumer welfare in ICT markets
  - No sign of regulation ‘withering away’.
- The range of issues covered in ICT regulation has grown hugely – bandwidth, quality of service, security, cost and price transparency, etc.
  - Spectrum availability and pricing has remained crucial;
  - New ‘affordable’ business and household broadband USO mandated in 2015;
  - Ofcom active in regulation of ‘multi-play’ contracts to ensure consumers have sufficient information and protection.
- Ofcom has retained a price controlled basic service for social security recipients and is now proposing a possible retail price control for fixed line telephone only subscribers (mainly elderly consumers).

# Affordability and ICT in UK: Developments since 2005

- Regulation being used increasingly to support effective competition: ‘regulation for competition’
- Ofcom has pioneered policies to empower consumers and encourage/persuade consumers to become more active e.g. over switching fixed and/or mobile providers
  - Perspective of 2016 Ofcom Strategic Review is that ‘unempowered’ consumers with limited information and high switching costs provide ICT companies with some degree of monopoly power;
  - Low income, low education level and older consumers most vulnerable;
  - Remedies mainly informational and promotional but price caps as last resort (as with fixed line only telephone subscribers).

# Affordability and ICT in UK: Developments since 2005

- Affordability issues of much more concern to Ofcom since 2006 but still much less than in electricity and gas (let alone water or commuter rail).
  - Continued sustained and rapid cost reductions and quality improvements in ICT from technical progress;
  - No ICT equivalent to fluctuating (imported) fossil fuel prices
  - No direct effects on life expectancy or health other than emergency service access.
- Various techniques available for consumers to use essential ICT services at very low cost => fewer and less serious budgetary control problems than for energy, water, commuter rail.
  - Think African mobile customers & refugees travelling to EU.

# Concluding Comments

1. Regulation has always actively involved affordability concerns for households and small businesses relative to companies with monopoly or near-monopoly power
  - Railway regulation invented for this post-1840 to protect small freight producers and passenger rail customers;
  - From 1890, similar (and more effective) protection extended in US to telecom, electricity and water consumers via Municipal, State and Federal regulatory agencies.
  - For UK and other OECD countries, private funding and regulation not used for after industry consolidation until after 1970

*Efficiency issues not a major concern - or in conflict with affordability - for energy and ICT until 1950s or later (always present for water and commuter rail).*

# Concluding Comments

2. In energy, use of retail price controls to generate affordability outcomes has been present in most countries and at most times - recent as well as distant.
- Problem of ensuring households can budget and pay for essential life-preserving services even if fossil fuel prices spike and real incomes are static/falling.
  - Problem of impact of sharply fluctuating fossil fuel and retail energy prices revealed by reductions in real incomes of lower income households 2009-11.

[Including housing costs, average weekly expenditure on fuel light and power rose from around 2.8% in 2003-04 to around 4.5% in 2011-12: the highest since the 1980s;

Excluding housing costs, the average share of gas and electricity in weekly family spending of the bottom decile of the income distribution rose from 6.3% in 2002 to around 9.5% in 2011-12, and hit 10.3% in 2009.]

# Concluding Comments

3. Affordability crises historically the best predictor of government intervention in the regulatory game.
  - Governments set the rules of the regulatory game as well as act as a player.
  - If they find the outcomes unacceptable, they can (and do) change the rules.
  
4. In my personal view, we need credible short-term intervention threat by concurrent regulators to deter companies from 'chiselling' rules
  - Encouraging active market participation and experiments a useful adjunct to this type of approach but, in my personal view, not an effective substitute.
  - This used to be common but Competition Commission advocated better to use ex post competition powers.
  
5. Unless GB and other countries can find an effective solution on these lines, economic history and political economy suggests that we will end-up with poorly designed and crude interventions.
  - Think Schelling!