

Finanzierung von Infrastrukturen

**Münchener Kreis Workshop
„Breitband nach 2018“**

Prof. Dr. Nico Grove

Assistant Professor

Institute for Infrastructure Economics &
Management

www.infrastructure-economics.com

Berlin, 30. Juni 2014



Agenda

Infrastrukturen im Zeitverlauf

Theoretischer Bezugsrahmen

Finanzierungsansätze

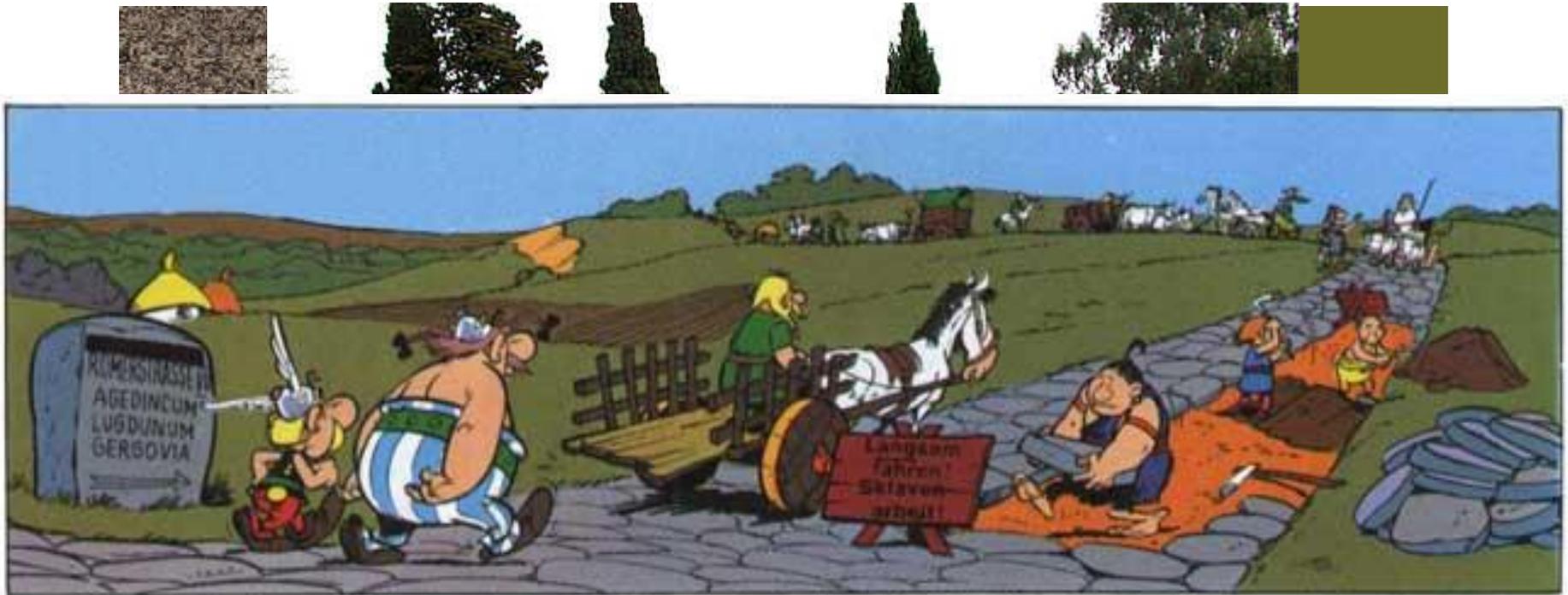
Zusammenfassung & Ausblick

Oh, wie schön ist Panama



a pictorial map of the PANAMA CANAL

(Konkurrierende) Infrastrukturen



(Konkurrierende) Infrastrukturen



(Konkurrierende) Infrastrukturen



(Konkurrierende) Infrastrukturen



(Konkurrierende) Infrastrukturen



Agenda

Infrastrukturen im Zeitverlauf

Theoretischer Bezugsrahmen

Finanzierungsansätze

Zusammenfassung & Ausblick

Infrastructure can be distinguished into physical existing and immaterial goods.

Infrastructure defined

Infrastructure

- Origin: infra [under, among] & struere [construct, build]
- Definition:
Infrastructure, in general public institutions, which are essential prerequisites for economic life¹⁾

tangible

- Traffic systems:
Streets, railways and transportation roads
- Utilities and disposal:
Energy, water, communication networks

intangible

- Human capital:
Education, research facilities
- Health system
- Social services
- Wider scope:
 - Standards
 - Virtual networks (Communities)

institutional

- Legal system
- Economic system
- Social system

- Wider scope:
 - Culture
 - traditions

Public Goods: Excludability and Diminishability

Public Goods

		Excludability from consumption	
		high	low
Diminishability (rivalry) in consumption	high	<p>Private goods (e.g. food, cars)</p>	<p>Collective or common goods (e.g. Road System, natural resources)</p>
	low	<p>Club goods (e.g. private schools, pay TV)</p>	<p>Public goods (e.g. national security, public TV)</p>

Public goods are characterized by non-rivalry and non-excludability in consumption¹⁾



1) Vgl. Olson (1965); Musgrave (1969)

The supply of merit goods has to be increased by the government, whereas demerit goods have to be reduced.

Merit Goods

Merit Goods

- Closely related to public goods are merit goods
- Musgrave in 1959 :
 - Individual underestimates the value of a specific good
 - Merit goods tend to be underconsumed.
 - Lower demand will lead to lower production capacity in the free market economy
 - Therefore, this good has to be supplied in a higher amount by the government or with governmental financial aid in order to fulfill social desirable higher supply of that good
- Examples:
 - Compulsory education
 - Compulsory health insurance
 - Public schools
 - Public culture and freedom of opinion

Demerit Goods

- The opposite of merit goods are demerit goods (or “demerit bads”)
- Unhealthy and socially undesirable for individual consumers and hence the entire society
- Examples:
 - Diseases
 - Famine
 - Flues
 - HIV
 - Pollution
 - Gaps in the society
- Free market does not lead to the social optimum, as at market equilibrium more of these demerit goods are produced or generated than desirable.
- Governments have to fund elimination of demerit goods in order to increase overall social welfare

Public good can either be supplied by the market, the government or under governmental control.

Provisioning Mechanisms

Supply of public and merit goods

Government based

- Provided by the state directly
- Requirements:
 - Independence
 - Sustainability
 - Long time commitment
- Examples:
 - Public safety via military defence
 - Police jurisdiction

Market based

- Government buys at market
- Provides below cost or for free to population
- Not providing these goods to the public outweigh the costs by a massive multiplier
- Examples:
 - Flu vaccine
 - Libraries
 - Culture

Regulated market based

- Market does not lead to social optimum price quantity combination
- In general the case for (former) monopolies
- Subadditivity (Baumol) increases problematic
- Examples:
 - Telecommunications
 - Post, etc.

Sector specific regulation

Agenda

Infrastrukturen im Zeitverlauf

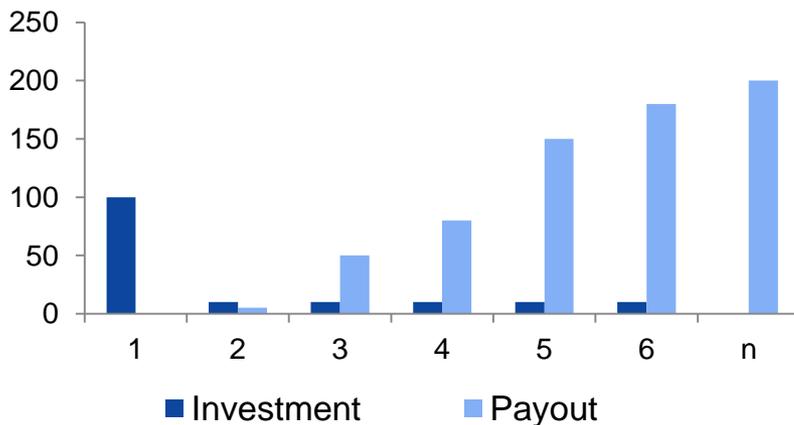
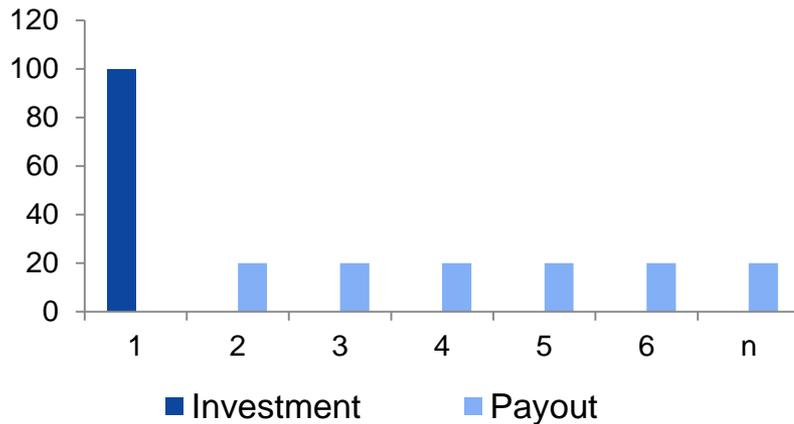
Theoretischer Bezugsrahmen

Finanzierungsansätze

Zusammenfassung & Ausblick

The creation of networks require massive upfront payments, followed by fixed or variable increasing/decreasing revenue streams.

Value Creation and Investment Plans



Project Amortization

- Annuity
 - Initial investment
 - Annual payment
 - Yield:

$$r = \frac{A}{I}$$

- Increasing returns
 - Initial high investment
 - Annual investments
 - Annual payment, increasing with number of users (e.g. exponentially)
 - Yield:

$$r = \frac{A \times u^2}{I}$$

CASE EXAMPLE

Background – Research Question

Railway Financing in Europe – Lessons from the 19th century

What makes good infrastructure...

... projects?

... investments?

... politics?

...

What are the boundaries of...

... investments?

... number of projects?

... regulation?

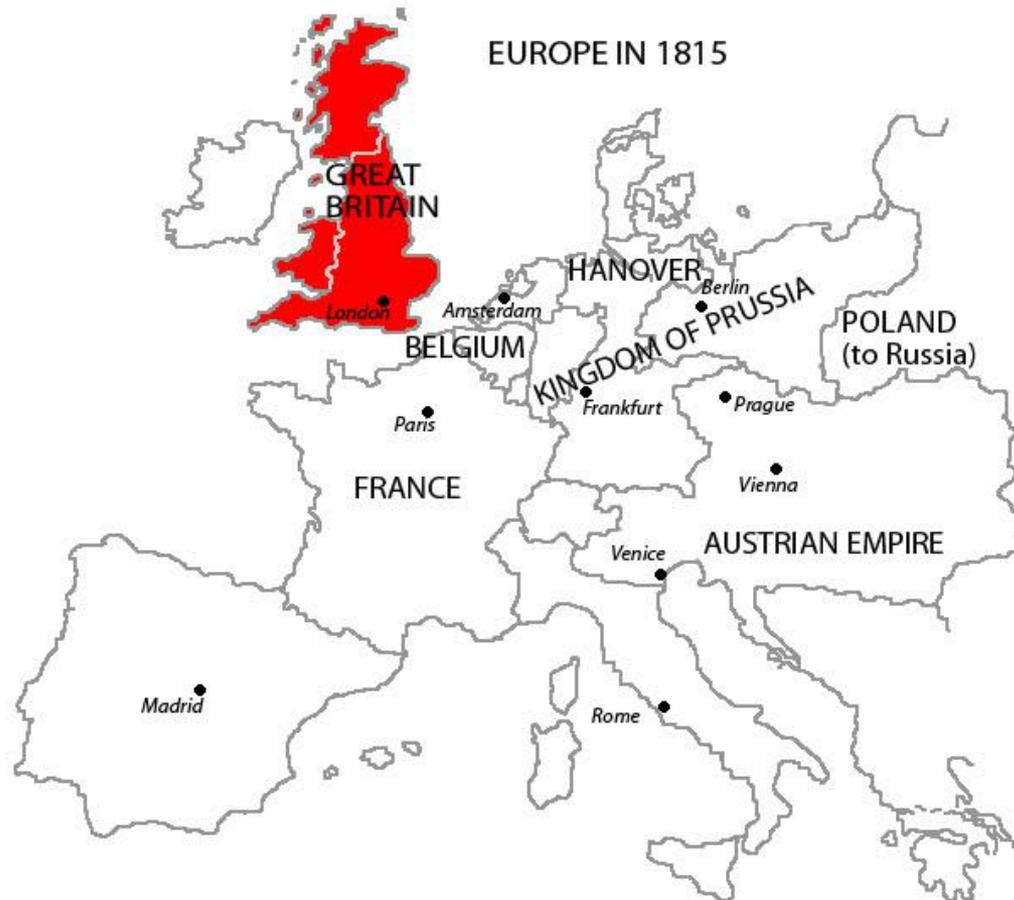
... public or private involvement?

...

CASE EXAMPLE

Background – Regional Analysis

Railway Financing in Europe – Lessons from the 19th century

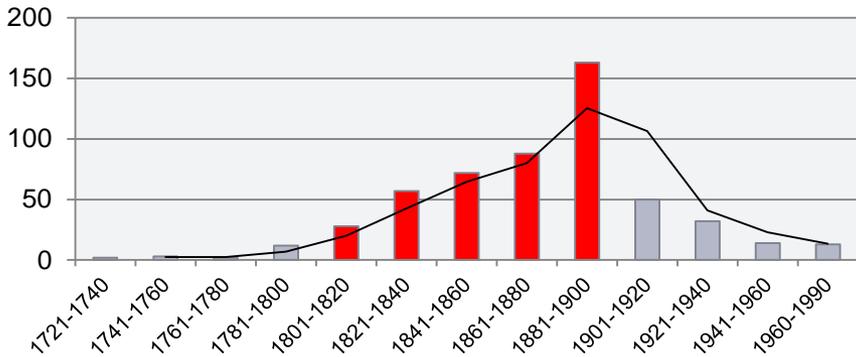


Background - Data

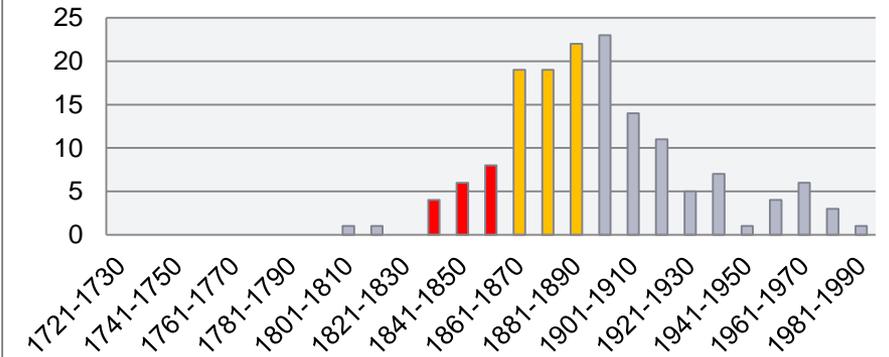
Railway Financing in Europe – Lessons from the 19th century

CASE EXAMPLE

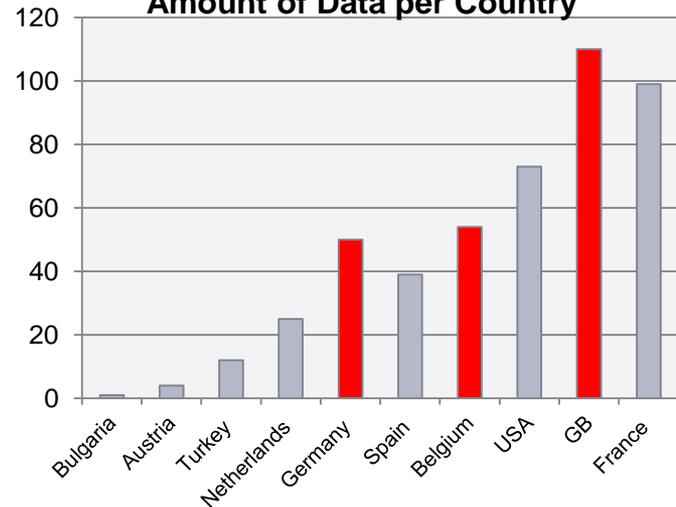
Amount of Data per Year



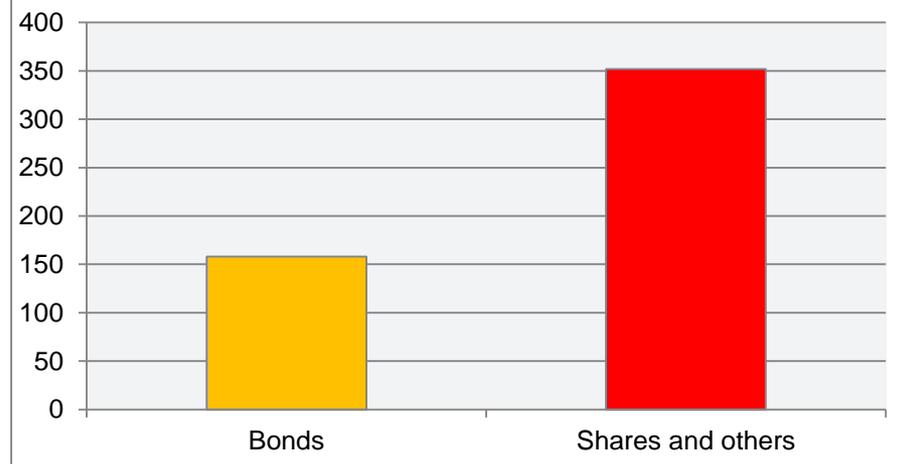
Amount of Bonds per Year



Amount of Data per Country



Amount of Bonds and Shares



Background – Framework for Analysis

Railway Financing in Europe – Lessons from the 19th century

CASE EXAMPLE

Historical Framework – 19th century

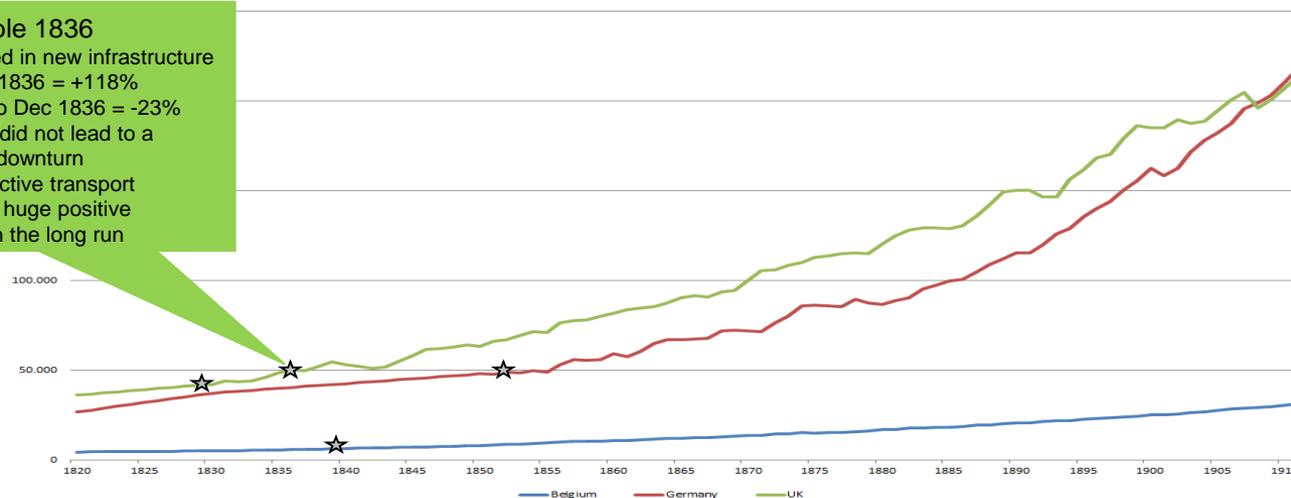
National / Cultural Framework – 19th century

- Belgium: Establishment of a railway network (1837 – 1842) as political/public project as part of the independence (1830 – 1836)
- Great Britain: Purely private railway enterprises regulated by government authorities.
- Germany: Mixed enterprises (public/private) in the beginning to gain know-how

First Railway Bubble 1836

- 8% of GDP invested in new infrastructure
- share prices 1835-1836 = +118%
- share prices May to Dec 1836 = -23%
- the railway bubble did not lead to a general economic downturn
- creation of a productive transport network that had a huge positive economic impact in the long run

GDP from 1820 - 1911 (in 1900 Int GK\$)



A. Maddison (2003): „The world economy: historical studies“ Development Centre Studies, OECD, p.46 ff

Background – Framework for Analysis

Railway Financing in Europe – Lessons from the 19th century

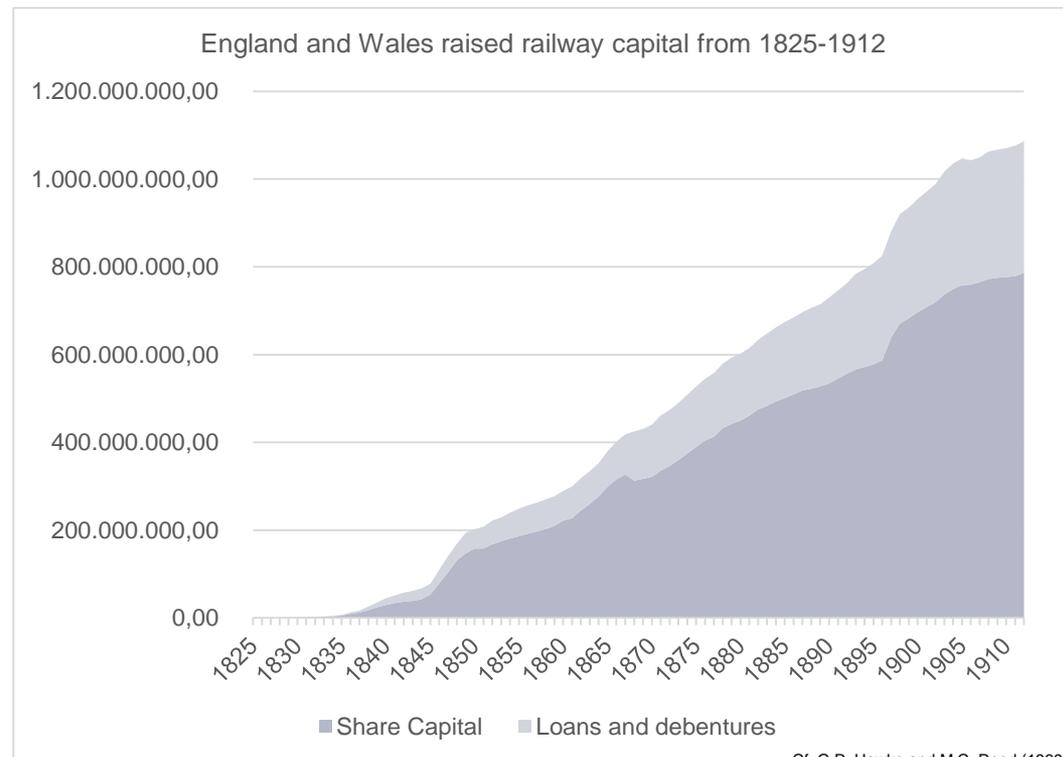
CASE EXAMPLE

Historical Framework – 19th century

National / Cultural Framework – 19th century

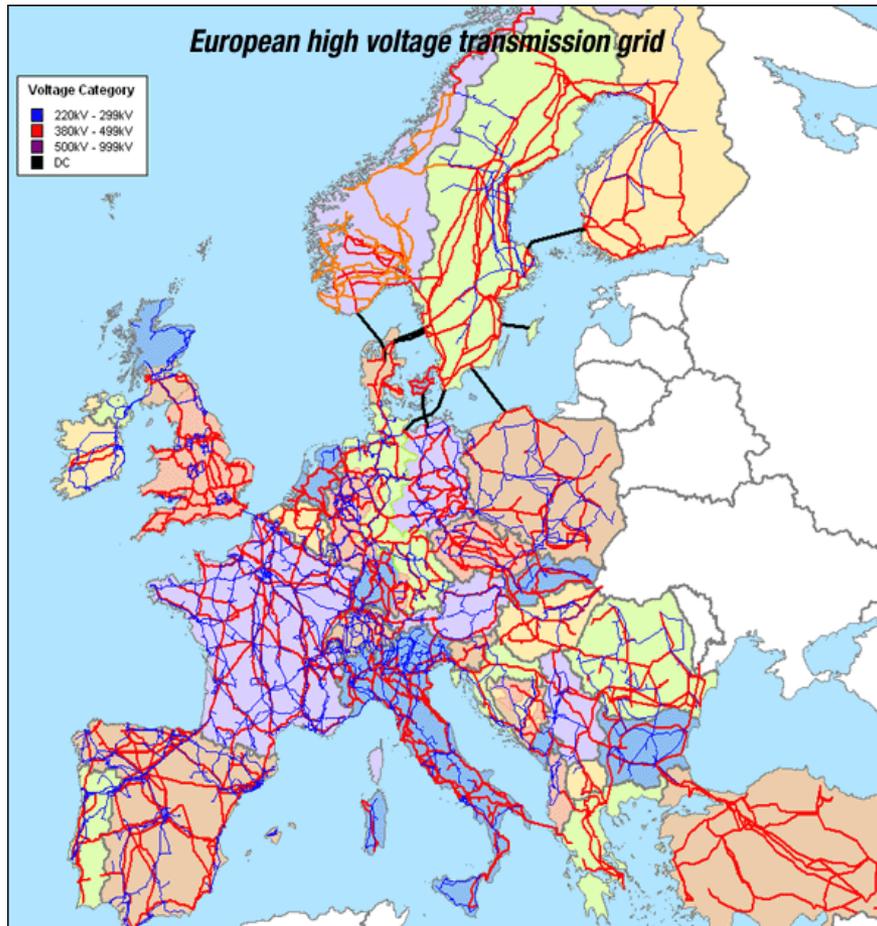
Sector Framework – 19th century

- Financing and market structure in the 19th century very different from today, although financial instruments and basic market mechanisms were almost identical
- Equity based investments in infrastructure
- Uncertainty of new technology leads to high return expectation of early investors = idiosyncratic risk of new asset class
- with adoption idiosyncratic risks turn into systematic risks, which leads to lower returns



Electric energy networks are consisting of transnational connection points and national distribution grids.

Electric Energy



Industry Characteristics

- Coverage
 - National
 - Transnational connections
- Initiator
 - Energy production companies
 - Government
- Competition
 - Very low degree on international level
 - Low degree on national level
 - Owned by energy production companies
- Market entry
 - Very low
- Specificity of Investments
 - Specified to electric energy

Gas pipelines originate at producing countries, acting as unidirectional transport and feeding network.

Gas



Industry Characteristics

- Coverage
 - Transnational
- Initiator
 - Gas production companies
 - Government
- Competition
 - Very low degree
 - Partially owned by governments
 - Partially owned by gas production companies
- Market entry
 - Very low
- Specificity of Investments
 - Highly specified to natural gas
 - No alternative transport good

The post network is characterized by competitive national and international hub and star topologies.

Post



Industry Characteristics

- Coverage
 - National and international
- Initiator
 - Government
 - Private post companies
- Competition
 - Very low degree on local level
 - Medium on national transport
 - High on international level
- Market entry
 - Very low on local level
 - Medium on national level
 - High on international level
- Specificity of Investments
 - Specific to transport of physical goods
 - Therein highly flexible

Railway networks are almost entirely monopolistic structured and show up only limited transnational connection points.

Railway

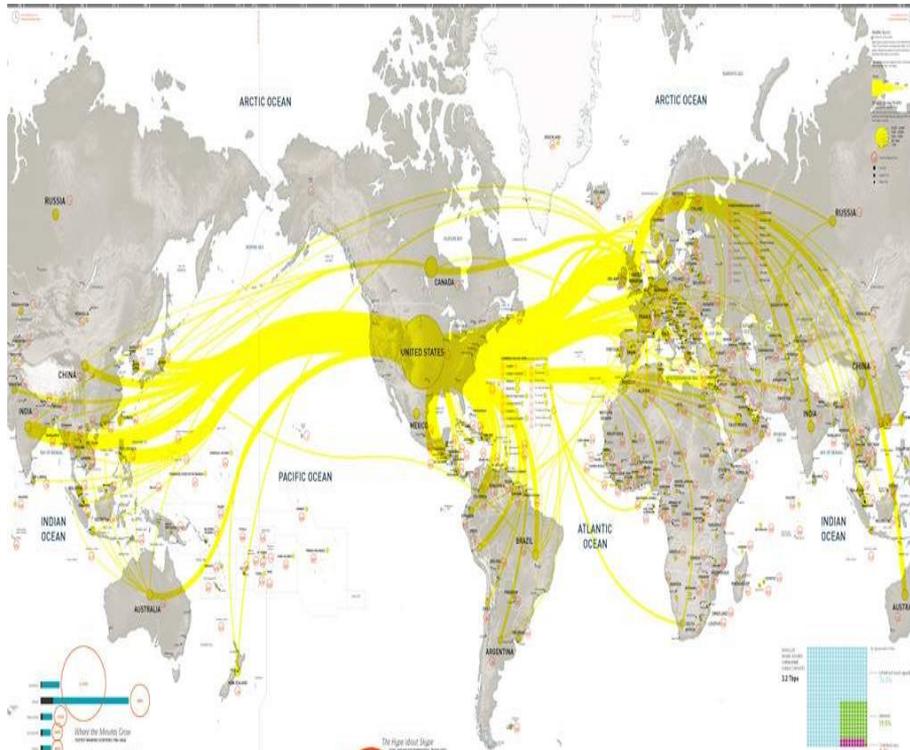


Industry Characteristics

- Coverage
 - National
 - Transnational connection points
- Initiator
 - Government
- Competition
 - Very low degree in national level
 - Very low degree on international level
 - Low degree on local level
- Market entry
 - Very low
 - Low on local level
- Specificity of Investments
 - Highly specified
 - Shift from passengers to freight and resectively

Telecommunications show up high competition levels on aggregation networks, whereas access networks are heavily dominated by former monopolies.

Telecommunications



Industry Characteristics

- Coverage
 - National
 - Transnational
- Initiator
 - Government
 - Private Investors
- Competition
 - Intense on national level
 - Medium on international level
- Market entry
 - Low for access network
 - Medium for aggregation network
 - Medium for backbone network
- Specificity of Investments
 - Specified to communications
 - Data and voice interchangeable

Fresh water networks are locally restricted, international or transnational connections do not exist.

Water



Industry Characteristics

- Coverage
 - National
 - No transnational connections
- Initiator
 - Government
 - Local municipalities
- Competition
 - Very low to low degree
 - Partially owned by municipalities
 - Privatization lacks due to health reasons
- Market entry
 - Very low
- Specificity of Investments
 - Specified to water

Financial markets are internationally (inter-)connected; competition exists on international, national and local level.

Financial Markets



Industry Characteristics

- Coverage
 - International
- Initiator
 - Government
 - Private investors
- Competition
 - Very high
 - Private companies
 - Public institutions
 - Hybrid forms
- Market entry
 - Intense
- Specificity of Investments
 - Specified to financial transactions

Where private streets exist, they compete against public available connections.

Streets

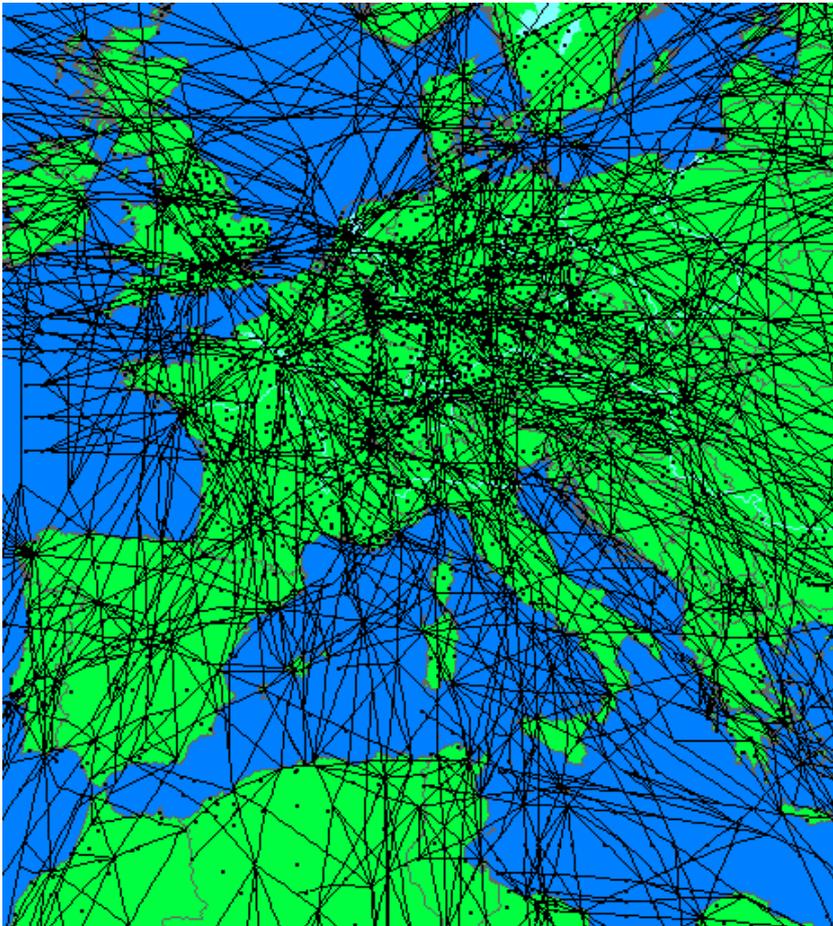


Industry Characteristics

- Coverage
 - National
 - Transnational connections
- Initiator
 - Government
 - Private companies
- Competition
 - Very low degree
 - In general provided by government
 - Public companies with alternative motorways (traffic toll)
- Market entry
 - Very low
- Specificity of Investments
 - Highly specified individual transport

For airway networks, competition exists for international connections, whereas some carrier allocate connections among them strategically.

Airways



Industry Characteristics

- Coverage
 - International
- Initiator
 - Governments
 - Private companies
- Competition
 - High on international level
 - Medium to low on national level
 - Partially owned by governments
- Market entry
 - High for charter
 - Low to very low for fixed routes
- Specificity of Investments
 - Highly specified to airtraffic

Agenda

Infrastrukturen im Zeitverlauf

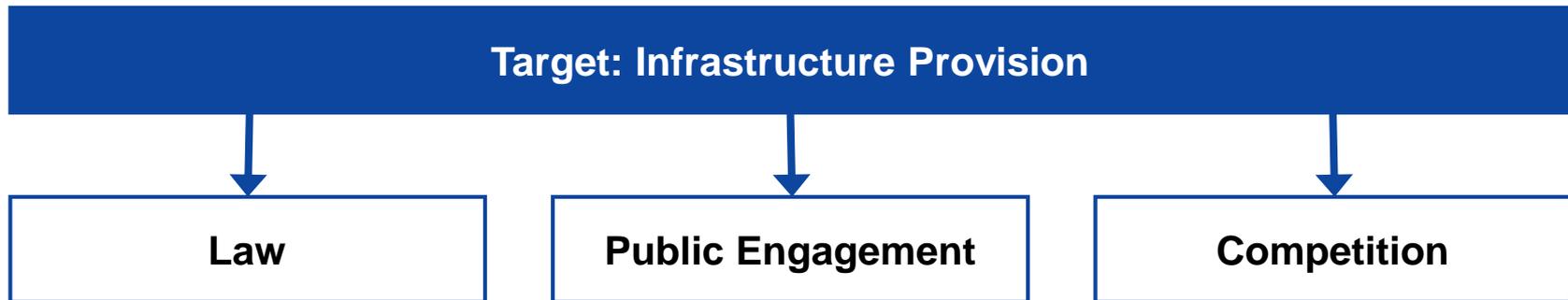
Theoretischer Bezugsrahmen

Finanzierungsansätze

Zusammenfassung & Ausblick

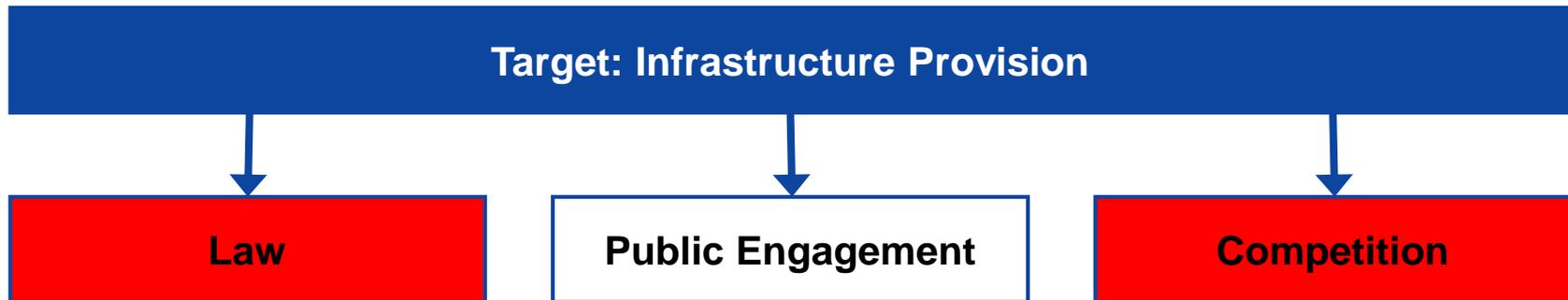
Framework for the implementation of Infrastructure (desired by multiple stakeholders)

Infrastructure Provisioning Scheme



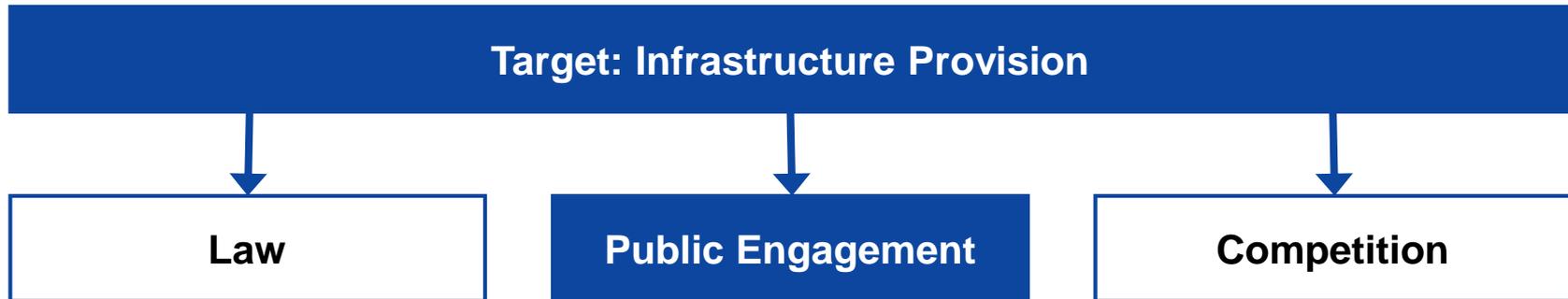
Framework for the implementation of Infrastructure (desired by multiple stakeholders)

Infrastructure Provisioning Scheme



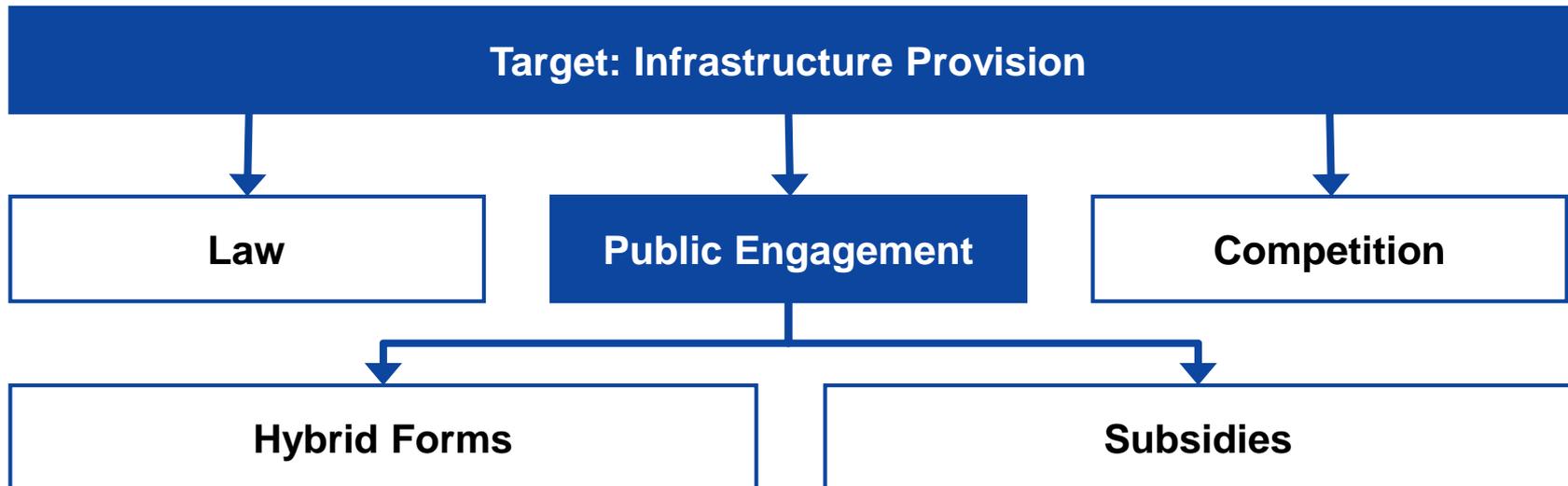
Framework for the implementation of Infrastructure (desired by multiple stakeholders)

Infrastructure Provisioning Scheme



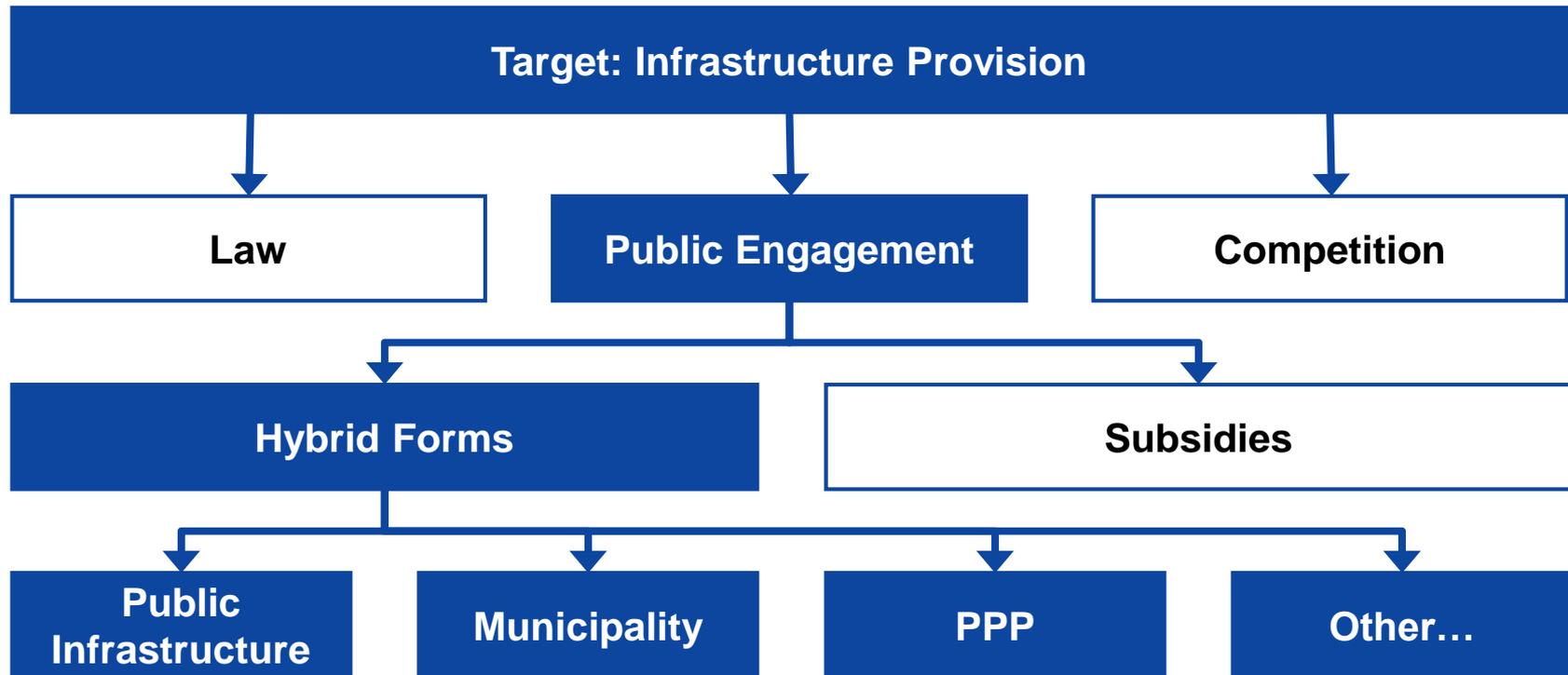
Framework for the implementation of Infrastructure (desired by multiple stakeholders)

Infrastructure Provisioning Scheme



Framework for the implementation of Infrastructure (desired by multiple stakeholders)

Infrastructure Provisioning Scheme



Vielen Dank!



nico@grove.ch