

**Why the focus on infrastructure?—  
economic importance, growth and  
welfare**

**Turin School of Local Regulation  
September 12, 2013**

**Ioannis N. Kessides  
Yale University**

# WHY THE FOCUS ON INFRASTRUCTURE?

- Accumulating evidence/widespread consensus on infrastructure's vital role for sustained, broadly shared economic growth and international competitiveness
- Infrastructure industries (network utilities) provide crucial services for manufacturing and commerce—significantly influence growth of national production and are thus vital to the public interest

# INFRASTRUCTURE-GROWTH NEXUS

- Issues surrounding the economics of public infrastructure still not well understood
- Link between public infrastructure and growth remains controversial
- A number of channels have been identified through which public capital can impact economic growth and productivity
- Lack of analytic clarity due to the multiplicity, complexity, and potential interaction of those channels

## KEY MESSAGES

Improved access to infrastructure (especially in developing countries) serves to:

- Increase factor productivity and reduce production costs
- Promote private capital formation
- Improve education and health outcomes
- Foster innovation
- Empower women by alleviating the constraint imposed on their time allocation

# **INFRASTRUCTURE-GROWTH: CONVENTIONAL CHANNELS**

1. Direct productivity and cost effect on private production inputs
2. Complementarity effect on private investment
3. Crowding-out effect on private spending

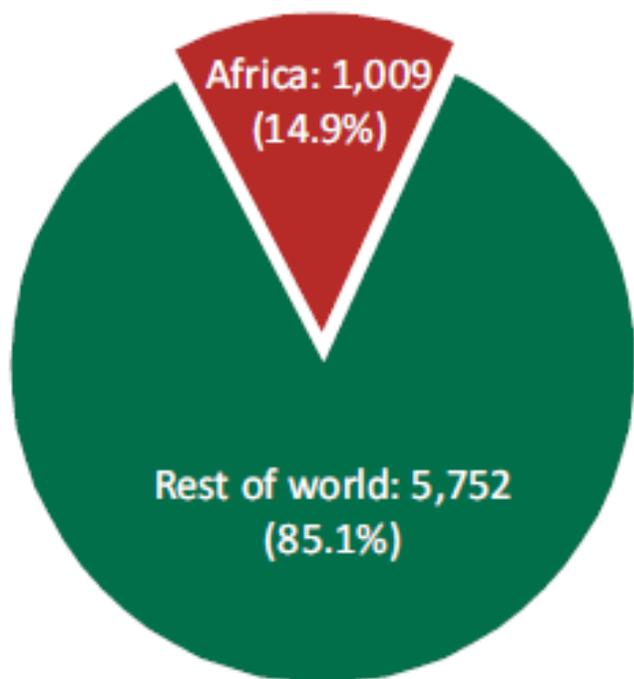
# PRODUCTIVITY AND COST EFFECTS OF INFRASTRUCTURE

- If production factors are gross complements then a higher stock of public capital raises the productivity of other inputs—public capital that is of high quality and available in greater supply will have a positive effect on the productivity of private inputs (labor and capital)
- In developing countries with low stocks of infrastructural assets, the marginal productivity effects of public capital are likely to be substantial

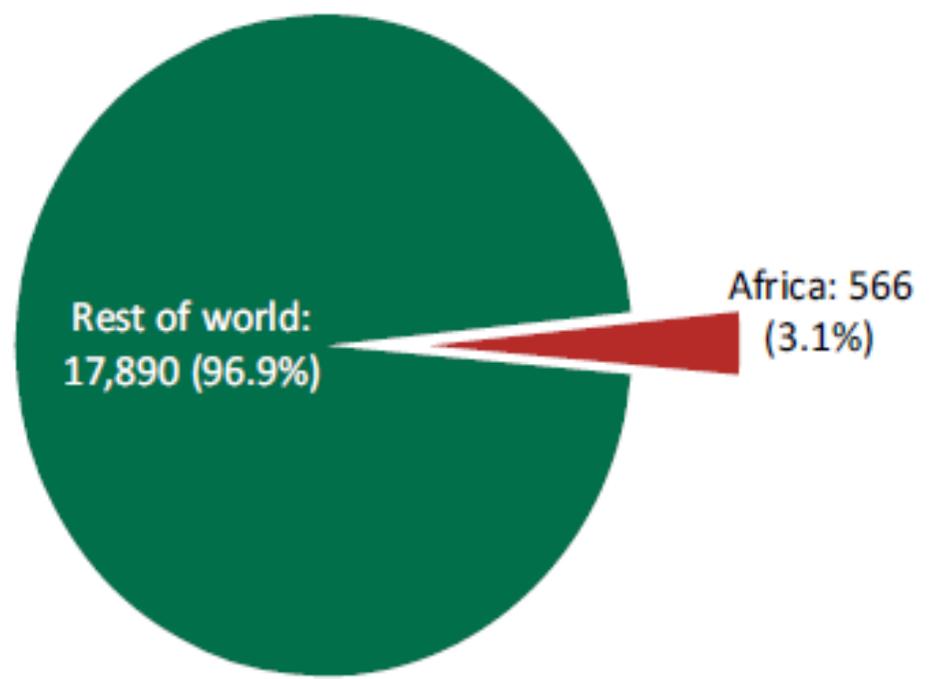
# **AFRICA'S POWER CRISIS SHORT-CIRCUITS SUSTAINABLE DEVELOPMENT**

- Some 25 (out of 44) countries in sub-Saharan Africa are facing crippling electricity shortages and extensive loadshedding—only about one-fifth of the sub-Saharan population has access to electricity
- Businesses cannot operate without expensive backup generators
- The normal rhythm of production cycle has been especially disrupted in electricity-intensive sectors like textiles, basic metals, rubber and plastic, paper, and leather products
- The total costs of loadshedding amount to more than 5 percent of GDP in Malawi, Uganda and South Africa

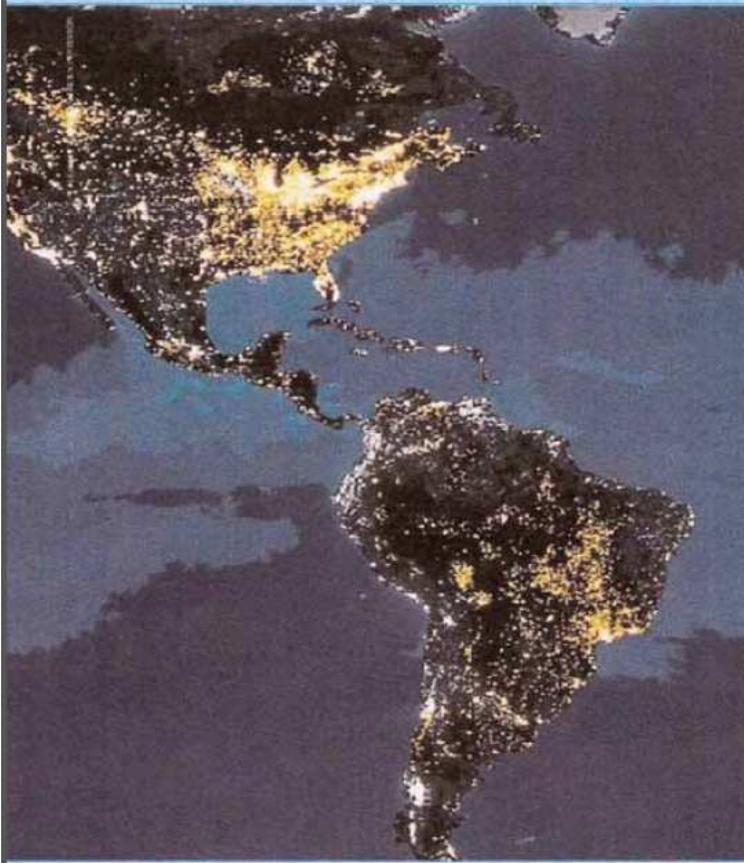
Population in millions



Electricity consumption in terawatt-hours



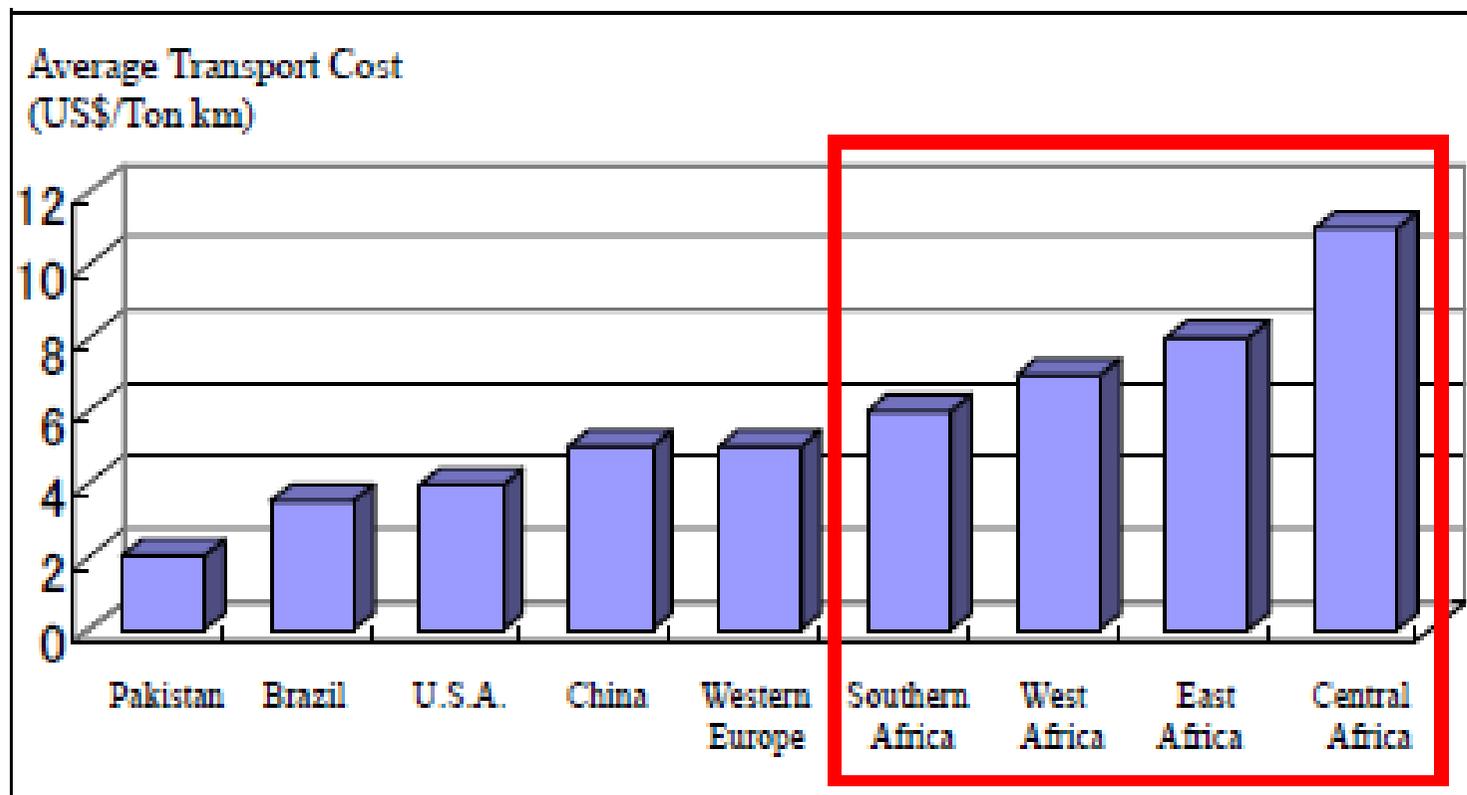
# **ELECTRICAL ILLUMINATION ON EARTH AS SEEN FROM SPACE**



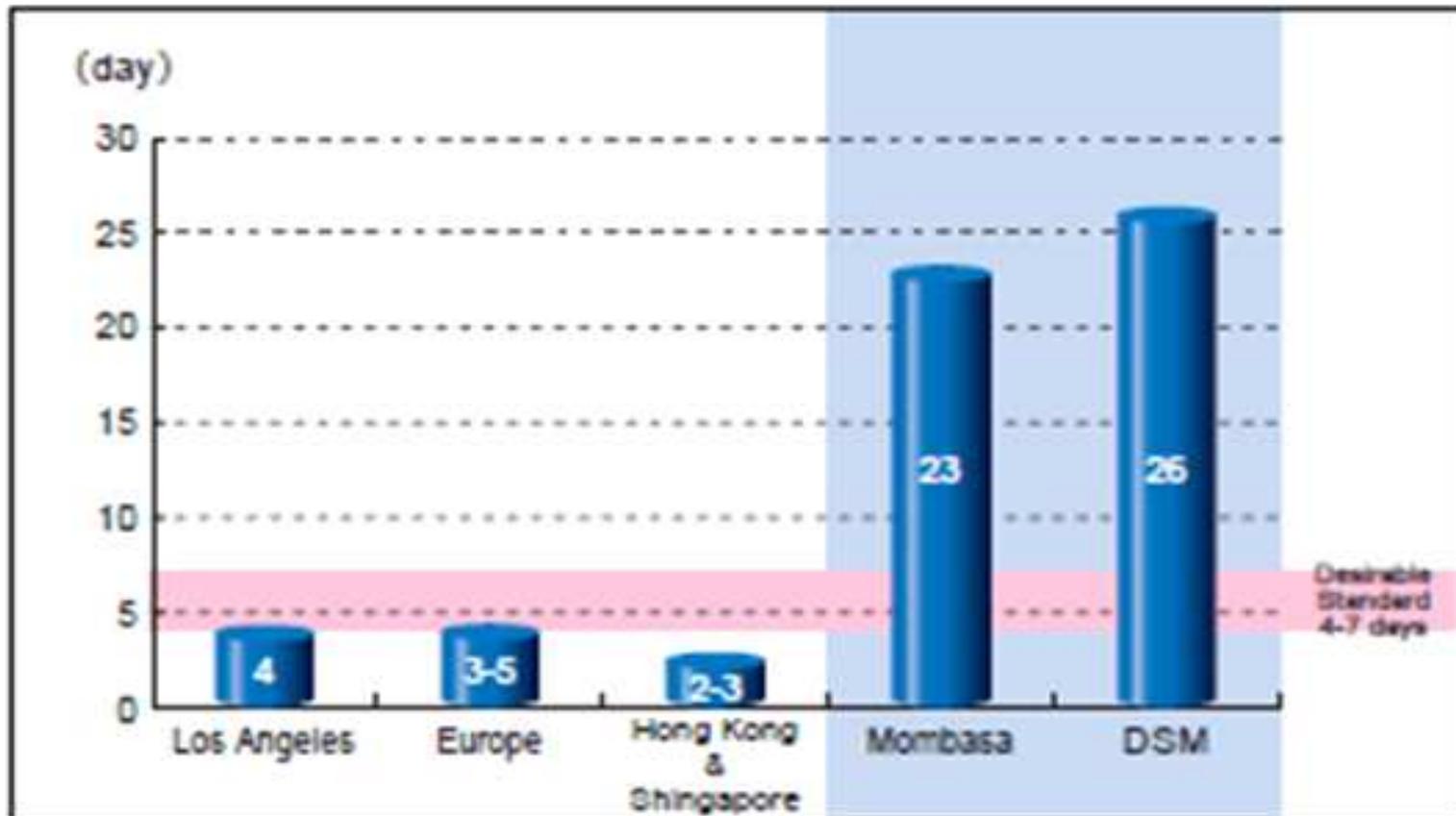
# **AFRICA'S CONNECTIVITY IS HAMPERED BY TRANSPORT BOTTLENECKS**

- Ports characterized by high levels of berth and yard congestion, and excessive dwell times
- Rail systems with incompatible gauges of track, poor service reliability and very low operating efficiency
- Regional roads a large portion of which have gravel surface and whose condition suffers from inadequate/deferred maintenance, overloading, and inefficient management
- Transport corridors that are suffering from serious delays due to informal stops and checkpoints some of which are imposed to collect payments for the police, transit authorities, and local communities
- Border crossings that are characterized by antiquated infrastructure, inadequate coordination, and congestion

# COMPARISON OF AVERAGE TRANSPORT COSTS



# WAITING TIME AT MAJOR PORTS IN EAST AFRICA



## **AFRICA'S INFRASTRUCTURE BOTTLENECKS—COST CONSEQUENCES**

- Transport and energy comprise 15% and 35% of firms' total indirect costs
- Poor infrastructure quality accounts for a large fraction of these costs
- A key reason for Africa's poor competitiveness and trade performance is the high cost of trade incurred in transporting goods across borders

# COMPLEMENTARITY EFFECT ON PRIVATE INVESTMENT

- By raising the marginal productivity of private inputs, public infrastructure increases the perceived rate of return on, and hence the demand for, physical capital by the private sector
- Countries with more and better infrastructure are likely to attract more FDI—as well as more domestic investment
- Positive effect of infrastructure on FDI has been found to be quite robust to time periods and countries considered

# **CROWDING-OUT EFFECT ON PRIVATE SPENDING**

- Distortionary taxes (to finance infrastructure spending) reduce the expected return on private capital and hence lower the propensity to invest
- Raising the cost of borrowing—in the face of limited resources for investment, if government uses more of those resources to invest in public capital there will be less available to the private sector or it will be more costly for the private sector to borrow
- Infrastructure investment-induced expansion in public borrowing can undermine the sustainability of public debt—risk premium of interest rates increases

## **EMPIRICAL EVIDENCE ON THE CROWDING-OUT EFFECT**

- The extent to which public sector investment has crowded-out the private sector remains in dispute—the empirical evidence is controversial and the literature is divided
- Small negative relationship between corporate tax rates and economic growth?
- Crowding-out or multiplier effects?—in Japan between 1998 and 2006, productive investments of the Japanese government financed by the issuing of bonds seem to have had a positive effect on the private sector

## **LINKS BETWEEN PUBLIC CAPITAL, KNOWLEDGE ACCUMULATION AND GROWTH**

- Microeconomic studies have uncovered evidence on the link between public capital and educational attainment
- A better transportation system helps raise school attendance
- Electricity allows more time to study and helps facilitating the use of electronic equipment and other devices that may enhance the learning process
- Human capital accumulation which requires not only public spending on education but also access to core infrastructure services
- An optimal expenditure allocation must be examined in a setting where both infrastructure investment and education outlays are productive components of public spending

# INFRASTRUCTURE AND HEALTH

- Better transportation networks allow for easier access to health care
- Access to electricity is essential for the functioning of hospitals and other health care facilities
- Access to safe water and sanitation reduces malnutrition and infant mortality
- Children of inadequately nourished mothers are more likely to suffer from health problems, and health in early childhood exerts a lasting influence on health and other outcomes (earning capacity) in later life

# IMPACTS OF PUBLIC CAPITAL ON INNOVATION

- Poor access to core infrastructure services (roads, electricity, and telecommunications) has a sizeable impact on the rate of knowledge acquisition and the capacity of developing countries to absorb foreign technologies and engage in innovative activities
- Inadequate transport/telecoms infrastructures may hamper the introduction of new products and the dissemination of new technologies
- Unreliable access to electricity may limit the use of advanced electronic devices used in research activities and cross-border knowledge sharing
- Increasing spending on infrastructure and universities may be more effective in stimulating R&D activities than general subsidies to research activities in the private sector

# FROM IMITATION TO INNOVATION—THE ROLE OF PUBLIC CAPITAL

- Imitation may be subject to decreasing returns (imitation trap)—switching from imitation to true innovation is essential for sustained growth
- Imitation (implementation innovation) requires investment in basic infrastructure (roads, basic telecoms, access to electricity, etc.)
- True innovation requires investment in advanced, R&D-promoting infrastructure—e.g. broadband infrastructure is critical
- Public capital, private capital, and highly educated labor are close complements in true innovation
- Lack of advanced infrastructure may mitigate the wage signal

# **PUBLIC CAPITAL AND WOMEN'S TIME ALLOCATION**

- Women in developing countries face a number of constraints on the allocation of their time between market and nonmarket activities
- Most channels through which infrastructure affect growth are not gender specific—still some of them may affect women disproportionately
- Lack of transport infrastructure constrains the ability of women to perform household production and income-generating activities (e.g. women in Africa travel on foot for 2.5 hours/day to meet their household's energy, water, and food needs)

## **PUBLIC CAPITAL AND WOMEN'S TIME ALLOCATION cont'd**

- Water and sanitation—women in low-income countries spend a significant amount of time (e.g. 27 hours/month or 15% of their monthly work time) collecting water for household production
- Lack of sanitation facilities can increase the school dropout rates for girls
- Lack of access to electricity constrains significantly women's time by forcing them to rely on fossil fuels (firewood)—it also hampers the ability of women to take care of their own and their children's health
- Intergenerational health externalities—women's time allocation affects health outcomes, productivity and wages in adulthood, and the overall growth process
- Women's lack of access to infrastructure can contribute to a gender gap in employment and wages

# IMPLICATIONS AND IMPORTANT INSIGHTS FOR POLICY DESIGN

- It is essential to account for the quality of public capital—the focus should not be on the level of spending but on maintenance, monitoring and the institutional framework within which the investment is undertaken
- In addition to the direct conventional channels (productivity/cost of private inputs and complementarity effect on private investment) through which public capital may affect growth there are also several indirect channels—the positive external effects on education and health outcomes, diffusion of new technologies, innovation capacity, and women's time allocation can magnify considerably the growth-enhancing effects of public investment in infrastructure and have substantial implications for the design, selection, and appraisal of core infrastructure projects

## **IMPLICATIONS AND IMPORTANT INSIGHTS FOR POLICY DESIGN cont'd**

- The network externalities associated with public capital imply that its benefits may depend on the stock of public capital itself—scale matters when it comes to infrastructure
- The nature of public capital to be supplied varies with the stage of development—basic infrastructure (roads, electricity, basic telecommunications) can sufficiently support imitation activities, while true innovation may require advanced type of infrastructure (more complementary with human capital, such as access to broadband)
- Investment in infrastructure is not just about promoting markets but also about education, health, and gender issues—frequently the most effective way to improve those human development outcomes is through investment in infrastructure

# EMPIRICAL FINDINGS

Literature is replete with contradictory empirical findings that are due to several factors:

- Severe measurement problems for economic variables that theory predicts are pertinent in the infrastructure-growth relationship
- Endogeneity of infrastructure measures and the lack of defensible instruments
- Functional specification issues
- Interaction of direct and indirect channels through which public capital may affect growth
- Unaccounted for network externalities and the concomitant nonlinearities that may characterize the growth enhancing effects of public capital

# **The Effects of Infrastructure Development on Growth and Income Distribution (Calderón and Servén)**

- A comprehensive empirical evaluation of the impacts of infrastructure on growth and income inequality
- A large data set including infrastructure quantity and quality indicators covering over 100 countries and spanning the years 1960-2000
- Estimating empirical growth and inequality equations with standard control variables augmented by the infrastructure quantity and quality measures
- Controlling for the potential endogeneity of infrastructure indicators

## Calderón and Servén (C-S) cont'd

Extensions to the previous literature:

- Considering simultaneously transport, power and telecommunications
- In contrast with earlier studies, which typically consider only quantity, C-S take into account both quantity and quality of infrastructure
- C-S explore the effects of infrastructure on both growth and distribution

## Calderón and Servén (C-S) findings

- The volume of infrastructure stocks has a significant positive effect on long-run economic growth--conclusion is robust to changes in the infrastructure measure used as well as the estimation technique applied
- Link between infrastructure quality and growth appears empirically less robust
- Infrastructure quantity and quality have a robust negative impact on income inequality
- Results reflect causal, and not merely coincidental, effects of infrastructure on growth and inequality
- Empirical findings are significant not only statistically but also economically
- Infrastructure both raises growth and lowers income inequality—therefore, infrastructure development may be a key win-win ingredient for poverty reduction