



## Land Transport Infrastructure

Senior Editors: Marco Gonzalez-Navarro, Román David Zárate

Co-Editors: Remi Jedwab, Nick Tsivanidis

# Land transportation in developing countries

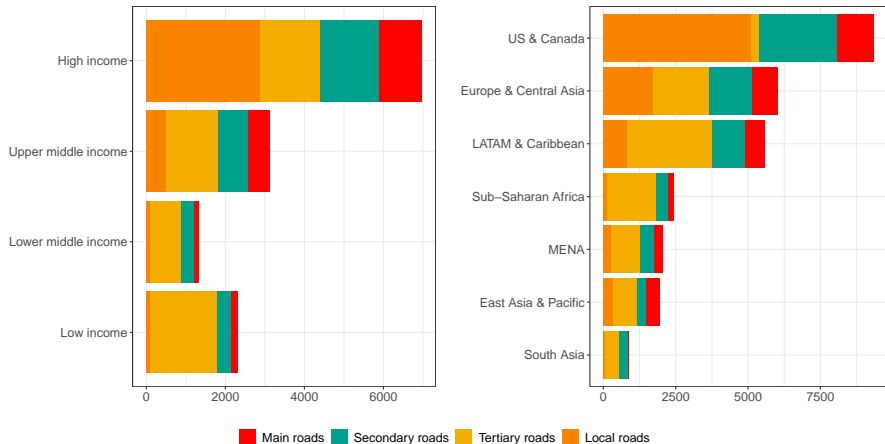
- Land transportation investments are substantial
  - \* World Bank's portfolio: \$33.2B, 10% of total lending
  - \* National govts spend up to 10% of GDP on infrastructure
  
- Infrastructure plays an important role in the economy
  - \* Facilitates market integration
  - \* Enhances long-term productivity
  - \* Improves the competitiveness of local actors in global markets
  
- We review:
  1. The land transportation **landscape** in developing countries
  2. **Frameworks** for evaluating the gains from transportation
  3. **Lessons learned** about the impact of land transportation
    - \* Interregional transportation
    - \* Intracity transportation

# Cost of transportation

- Land transportation is more expensive in developing countries
  - \* Road transport costs per tonne-km: \$0.17 in Central America vs. \$0.02 in USA (Osborne, Pachón, and Araya 2014)
  - \* Trade costs increase with distance 4-5× faster in Africa than in the US (Atkin and Donaldson 2015)
  - \* Median trade costs in Africa are 5× those in the rest of the world (Porteous 2019)
  
- High costs can stem from:
  - \* Little, sparse infrastructure
  - \* Low quality, reliability
  - \* Market power of operators and intermediaries
  - \* Expensive or ineffective procurement

# Quantity of transportation

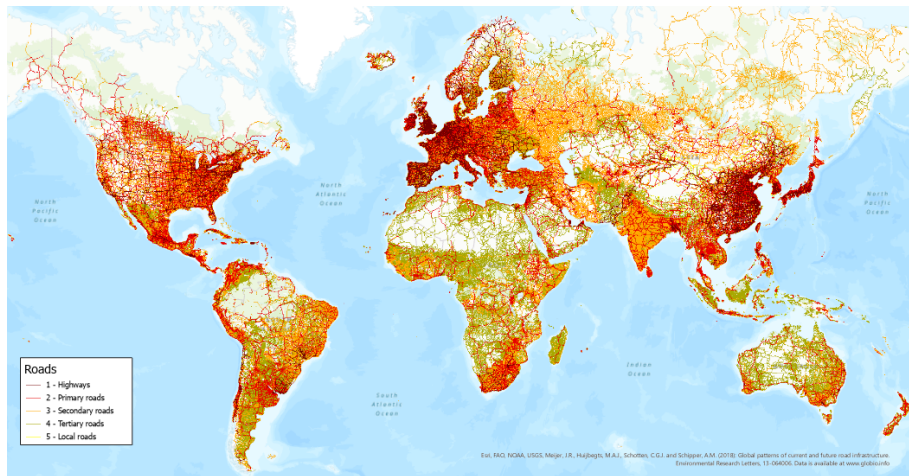
Figure: Road extent per capita



Notes: Population-weighted average across countries of a given income/region of the country's road extent per million inhabitants in 2018. Road extent information is taken from data compiled by Meijer et al. (2018).

# Spatial Distribution of Roads across the Globe

**Figure:** Spatial distribution of roads across regions



Notes: This figure shows the worldwide spatial distribution of roads using data from the World Bank

# Spatial Distribution of Railways across the Globe

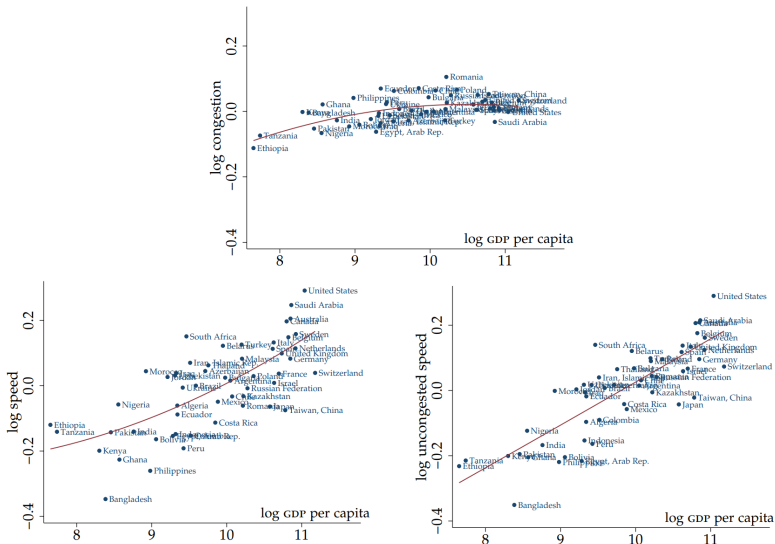
**Figure:** Spatial distribution of railways across regions



Notes: This figure shows the worldwide spatial distribution of railways using data from the World Bank

# Quality of urban transportation vs. GDP per capita

**Figure:** Relationship between speed and congestion with income per capita



Notes: This figure shows the relationship between speed and income per capita. Source: Akbar et al. 2023a

# Quality of transportation

Land transportation services in developing countries are also lower quality:

- Low rates of road paving

Mesquita Moriera et al. (2013) and Foster and Briceno-Garmendia (2010)

- Uncertainty in travel time → lower use, higher inventories

Iimi et al. (2019) and Datta (2012)

- Lower capacity

Coşar and Demir (2016)

- Crime and corruption payments

Olken and Pande (2012)

- Slow urban speeds – congested & uncongested

Akbar et al. (2023b)



## Challenges: Procurement & placement

- Procurement and placement decisions are complex processes
  - \* Strong institutions to function well
  
- Corruption → inflated costs, poor quality
  - Chen (2023) and Collier, Kirchberger, and Söderbom (2016)
    - \* Quality, costs difficult to observe
    - \* Institutions can improve outcomes:
      - \* audits (Olken (2007), Indonesia)
      - \* e-procurement (Lewis-Faupel et al. (2016), India, Indonesia)
  
- Political, ethnic favoritism can bias placement
  - \* Worse in non-democratic periods Burgess et al. (2015), Kenya
  - \* Favor resource extraction Bonfatti and Poelhekke (2017), Africa
  - \* Used to buy votes Bonilla-Mejía and Morales (2023), Colombia
  - \* Lucrative contracts go to relatives Lehne, Shapiro, and Vanden Eynde (2018), India

## Challenges: Financing

- Government revenue in developing countries is low as a share of GDP
  - \* Incentivize Public-private partnerships (PPP)?
  
- Little research on these arrangements
  - \* Some evidence PPPs are not necessarily improvements over public provision  
Trebilcock and Rosenstock (2015) and Fabre and Straub (2023)
  - \* May be more expensive in the presence of market power  
Bogart and Chaudhary (2012)
  
- Increased attention on Land value capture models  
Suzuki et al. (2015)
  
- Information on costs can be difficult to obtain

# Conceptual Framework to evaluate Infrastructure Effects

# Evaluating the benefits of infrastructure

- Seminal approaches focused on the time/cost savings:
  - \* Compare new transport options with the best alternative technology (Fogel 1964; McFadden 1974)
  - \* Railways in the US generate negligible effects
  
- Two fundamental challenges:
  1. **Identification:**
    - \* Infrastructure not randomly placed → confounded causal inference
  2. **General equilibrium effects:**
    - \* Spillovers to regions not directly treated: Relocation/reallocation increase benefits
    - \* Relocation or growth?

## Identification: Historical route instruments

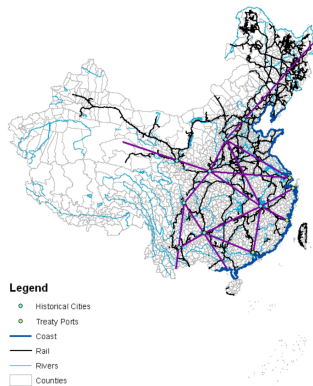
### Historical route or city instruments predict actual routes

- Path-dependence:

(Martincus, Carballo, and Cusolito 2017; Banerjee, Duflo, and Qian 2020)

### Instrument:

- Historic routes predict modern routes (relevance), and ...
- May be independent of recent productivity, amenity shocks (exogeneity)



Banerjee, Duflo, and Qian (2020)

# Identification: Incidental connection instruments

## Incidental connection instruments

- Infrastructure connects major points of interest
- Some places along the way get connected by chance

## Instrument:

- Least-cost paths

Faber (2014), Morten and Oliviera (2023), and Fenske, Kala, and Wei (2023)

- Shortest routes

Banerjee, Duflo, and Qian (2020), Jedwab and Moradi (2016), Ghani, Grover Goswami, and Kerr (2016), and Garcia-Lopez, Holl, and Viladecans-Marsal (2015)



Faber (2014)

# The challenge of general equilibrium effects

- Relocation or growth?
  - \* Empirical tests assume spillovers are local → exclude nearby areas
  - \* Challenging if spillovers are not spatially concentrated
  
- Transportation networks →
  - \* Changes in production output, prices, wages, trade and commuting shares
  - \* Price and income effects in all locations
  
- New economic geography models of trade and iceberg transport costs
  - \* Compute the economic impacts in all regions  
Allen and Arkolakis (2014), Redding and Rossi-Hansberg (2017), Allen, Arkolakis, and Li (2020), and Allen and Arkolakis (2022)
  - \* Apply gravity to commuting  
Ahlfeldt et al. (2015)
  
- “Market access”: sufficient statistic that aggregates impacts via access to trade  
Donaldson and Hornbeck (2016) and Ahlfeldt et al. (2015)

# Interregional Transport



## Rail: Periphery to port

- Colonial governments developed many rail investments in LI and MI countries
  - \* Resource extraction and exports
  
- Empirical evidence of positive impacts on GDP:
  - Jedwab and Moradi (2016), cocoa areas in Ghana
    - \* Empirical (spatial) tests for spillovers find limited evidence of relocation
    - \* Ability of factors to relocate is key for gains to materialize
      - Banerjee, Duflo, and Qian (2020), China
  
- Policy relevance for modern investments unclear

# Rail: Connecting regions to each other

- Evidence (largely from India) suggests rail connections → + economic impacts
  - \* Improves market access
  - \* Expand local industries
  
- Evidence from the literature:
  - \* Donaldson (2018) – Ricardian model of trade
    - \* Large gains from 19th century rail in India
    - \* Model → own trade share is sufficient statistic for welfare
  
  - \* Fenske, Kala, and Wei (2023) – least-cost instrument
    - \* Colonial rail made connected cities in India larger
  
  - \* Jedwab, Kerby, and Moradi (2017)
    - \* Urban path dependence from rail connections in Kenya

# High-speed passenger rail

- We know less about these newer types of passenger trains
  - \* Evidence from China suggests that productivity and workers' welfare increase
  
- Evidence from the literature:
  - \* Tian and Yu (2023) - effects on firms
    - \* HSR increases export volumes and labor productivity in China
  - \* Barwick et al. (2022) - effects on workers
    - \* HSR reduces exposure to extreme pollution and high temperatures

## Highways: Periphery to port

- Highways connecting remote areas to ports/major cities can be transformative
- However, initial conditions matter for the materialization of these effects
- Evidence from the literature:
  - \* Agricultural areas may further specialize, leading to slower manufacturing growth  
Faber (2014), China; Jedwab and Storeygard (2022), African countries
  - \* Industrial areas in particular benefit  
Ghani, Grover Goswami, and Kerr (2016), India; Martincus, Carballo, and Cusolito (2017), Peru
  - \* Trade integration improves allocative efficiency, markups  
Asturias, García-Santana, and Ramos (2019), India
  - \* ... and integrate labor markets, promoting specialization  
Morten and Oliviera (2023) and Pellegrina and Sotelo (2023), Brazil;  
Baldomero-Quintana (2022), Colombia

## Highways: Connecting regions to each other

- Highways connecting small/medium cities may generate on net positive gains
- However, not all regions benefit equally
- Evidence from the literature:
  - \* Benefits are largely net positive
  - \* Large dispersion between regions with some areas declining in some cases  
Bird, Lebrand, and Venables (2020) and Lall and Lebrand (2020), BRI Central Asia; Coşar (2022), Turkey; Sotelo (2020), Peru
  - \* Models ignoring GE effects, rerouting understate benefits  
Fan, Ti, and Luo (2023), China
  - \* Where highways should be placed matters for benefits
    - \* Climate change erodes benefits  
Balboni (2023), Vietnam
    - \* Biases for resource extraction, large cities → miss out on gains  
Bonfatti and Poelhekke (2017), Africa; Alder (2023), India

## Rural or last-mile roads

- Rural roads encourage technology adoption and sectoral reallocation

Asher and Novosad (2020) and Shamdasani (2021), India; Gebresilasse (2023), Ethiopia

- ... but the most remote areas fail to see increases in income

Alder et al. (2022), Ethiopia; Mitnik, Sanchez, and Yañez (2018), Haiti; Asher and Novosad (2020) and Shamdasani (2021), India

- With some important exceptions:

- \* Gertler et al. (2019), highways in Indonesia
- \* Brooks and Donovan (2020) river bridges in Nicaragua

- Initial conditions and institutions matter to materialize the gains

## Areas for future work: Interregional transportation

- How important is road quality versus quantity?
  - \* Is the muted relationship between rural roads and incomes related to quality/capacity/costs?
  
- Relationship between infrastructure and distortions/market failures?
  - \* Deviate from the iceberg assumption: include a transportation sector
  - \* Market power in the intermediary sector
  
- How at risk are transportation networks to climate change?  
(Balboni 2023)
  
- Do transportation networks generate environmental externalities in GE?  
(Araujo, Juliano, and Bragança 2023)

# Intracity Transportation



# Intracity transportation

- What is the economic impact of highways, subways, buses, BRT?
  - \* Bus Rapid Transit (BRT) → buses with dedicated lanes
  - \* Can also think of policies like tolls, HOV lanes
  
- Shares similar framework as interregional transportation
  - \* Gravity to commuting flows instead of trade flows
  - \* It can also generate GE effects
  
- However, there are some key differences:
  1. Transit primarily moves **people** (commuters) vs. goods
  2. Transit options also attempt to address **externalities** (congestion, smog, etc.)

# Road transit and urban economic geography

- Infrastructure promotes sprawl, but less available evidence than for the US  
Bluhm et al. (2023), Many developing countries
- Connecting commuters to jobs leads to higher gains than just time saved
  - \* Increasing market access → more benefits in GE  
Tsivanidis (2022), BRT Bogotá
  - \* Residents on upgraded routes directly value benefits  
Gonzalez-Navarro and Quintana-Domeque (2016), road paving Mexico
- Total use of public transit decreases with income
- However, transit investments may not be pro-poor due to GE effects:
  - \* Relocation effects matterTsivanidis (2022), BRT Colombia; Balboni et al. (2020), BRT Dar Es Salaam

# Roads and congestion

- New mobile data: Developing country cities have very slow speeds.
  - \* Speeds in high income countries are 50% faster than low income country cities Akbar et al. (2023b), India
  - \* Speeds are slow even at uncongested times Akbar et al. (2023a), India
  
- Commuters have inelastic demand for departure times:
  - \* Congestion taxes may be ineffective Kreindler (2022), Jakarta; Akbar and Duranton (2017), Bogotá
  
- Less available evidence on other congestion policies
  - \* HOV lanes mitigate delays in Jakarta Hanna, Kreindler, and Olken (2017)
  - \* Addressing encroachment: routes may be promising policies Akbar et al. (2023a)

## Roads and other externalities

- Vehicles generate more negative effects than just congestion:
  - \* Greenhouse gases, carbon monoxide, particulate matter
  - \* Accidents → morbidity, mortality
  - \* Noise
  
- These externalities impose very high costs for welfare:
  - \* It is very difficult to measure these externalities
  - \* How to design instruments that replicate Pigouvian taxes
  
- Regulating these externalities is challenging
  - \* We know little on how to design policies for regulating vehicle externalities  
Davis (2008) and Oliva (2015), Mexico City
  - \* Messaging about accidents in Kenyan minibuses effective in reducing accidents  
Habyarimana and William (2015)

# What is the right amount of public transportation?

- Public transit networks tend to trade off
  - \* **frequency** of service
  - \* **more extensive** network
  
- Evidence from the literature:
  - \* More minibuses increase welfare by decreasing wait time in Cape Town  
Conwell (2023)
  - \* Optimal BRT network would be more extensive in Jakarta  
Kreindler et al. (2023)
  
- Importance for studying several questions
  - \* Informal transportation modes in developing countries
  - \* Design the optimal frequency of buses or trains
  - \* Motorization

## Subways, light rail and cable cars

- Globally, urban rail causes decentralization, but to a lesser extent than roads  
Gonzalez-Navarro and Turner (2018)
- Urban rail and cable cars connect residents to opportunity in the form of:
  - \* formal employment Zarate (2023), Mexico City
  - \* non-criminal employment Khanna et al. (2022), Medellín
  - \* collaboration and innovation Koh, Li, and Xu (2023), Beijing
- Subway expansions can substitute for car use and lead to improved air quality  
Gendron-Carrier et al. (2022), globally; Gu et al. (2021), China
- ... but low quality may hinder demand  
Gaduh, Gračner, and Rothenberg (2022), Jakarta

## Areas for future work: Intracity transit

- What policies would be effective at improving the quality of public transit?
- What is the substitutability or complementarity between transit options?
  - \* Origin-destination surveys
  - \* How does this affect the magnitude of the gains to residents?
- Does the geography of a city matter for optimal infrastructure investments?
  - \* Pancakes vs. pyramids Lall et al. (2021)
  - \* Skyscrapers revolution Remi Jedwab and Baum-Snow (2023)
- Impacts of increased motorization, ride share apps, and other gig services?  
Rhotenberg and Du (2023)

# General Overview and Areas for Future Research



## Summing up

- Recent research has studied land transportation in developing countries
  - \* Infrastructure investments have the potential to generate large gains
  - \* These investments can also generate substantial regional inequalities
  - \* Still questions on how to finance them
- GE models have facilitated nuanced analysis of transportation investments
  - \* As a whole effects are aggregate
  - \* They are not just a reshuffling of economic activity
- Intercity transit options:
  - \* Benefit relatively more developed areas than rural ones
  - \* Lead to more specialization
  - \* The gains depend on the initial conditions
- Intracity transportation:
  - \* Has shown to generate significant gains in productivity
  - \* GE affects can make them less pro-poor

## Future Research

- Emerging research is leveraging **novel data** to study several questions:
- The dynamic impacts of infrastructure:
  - \* Relationship with climate change
  - \* Relationship with path-dependence: capital and labor
- Interaction with market failures: pollution, market power
  - \* Market power in the transportation sector
  - \* Pollution generated by roads and transport
- The distributional consequences of transit investments
  - \* Effects along the income distribution
  - \* Dynamic models to study sorting Warnes (2021)
- Characterizing the optimal transportation network
  - \* How does it depend on the geography and initial conditions?
  - \* Can it generate a big push?

## References I

-  Ahlfeldt, Gabriel M. et al. (2015). “The Economics of Density: Evidence From the Berlin Wall”. In: *Econometrica* 83.6, pp. 2127–2189. URL: <https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA10876>.
-  Akbar, Protoy and Gilles Duranton (2017). “Measuring the cost of congestion in a highly congested city: Bogotá”. In: *CAF Working paper*.
-  Akbar, Protoy et al. (2023a). “Mobility and Congestion in Urban India”. en. In: *American Economic Review* 113.4, pp. 1083–1111. URL: <https://www.aeaweb.org/articles?id=10.1257/aer.20181662>.
-  Akbar, Protoy A. et al. (2023b). “The Fast, the Slow and the Congested: Urban Transportation in Rich and Poor Countries”. In: *NBER Working Paper No. 31642*.
-  Alder, Simon (2023). *Chinese Roads in India: The Effect of Transport Infrastructure on Economic Development*. Working Paper.
-  Alder, Simon et al. (2022). “The Impact of Ethiopia’s Road Investment Program on Economic Development and Land Use: Evidence from Satellite Data”. In: *World Bank Policy Research Working Papers*. DOI: 10.1596/1813-9450-10000. URL: <https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-10000> (visited on 06/05/2023).


## References II

-  Allen, Treb and Costas Arkolakis (2014). “Trade and the Topography of the Spatial Economy”. In: *The Quarterly Journal of Economics* 129.3, pp. 1085–1140. DOI: [10.1093/qje/qju016](https://doi.org/10.1093/qje/qju016). (Visited on 05/31/2023).
-  — (2022). “The Welfare Effects of Transportation Infrastructure Improvements”. In: *Review of Economic Studies* 89.6, pp. 2911–2957. URL: <https://academic.oup.com/restud/article/89/6/2911/6519332>.
-  Allen, Treb, Costas Arkolakis, and Xiangliang Li (2020). “On the Equilibrium Properties of Network Models with Heterogeneous Agents”. In: *NBER Working Paper 27837*.
-  Araujo, Rafael, Assunção Juliano, and Arthur Amorim Bragança (2023). “The Effects of Transportation Infrastructure on Deforestation in the Amazon: A General Equilibrium Approach”. In: *World Bank Policy Research Working Paper 10415*.
-  Asher, Sam and Paul Novosad (2020). “Rural Roads and Local Economic Development”. en. In: *American Economic Review* 110.3, pp. 797–823. ISSN: 0002-8282. DOI: [10.1257/aer.20180268](https://doi.org/10.1257/aer.20180268). URL: <https://www.aeaweb.org/articles?id=10.1257/aer.20180268> (visited on 06/05/2023).

## References III

-  Asturias, Jose, Manuel García-Santana, and Roberto Ramos (2019). “Competition and the Welfare Gains from Transportation Infrastructure: Evidence from the Golden Quadrilateral of India”. In: *Journal of the European Economic Association* 17.6, pp. 1881–1940. URL: <https://ideas.repec.org/a/oup/jeurec/v17y2019i6p1881-1940..html>.
-  Atkin, David and Dave Donaldson (2015). “Who’s Getting Globalized? The Size and Implications of Intra-national Trade Costs”. In: *NBER Working Paper* 21439. DOI: [10.3386/w21439](https://doi.org/10.3386/w21439).
-  Balboni, Clare (2023). “In Harm’s Way? Infrastructure Investments and the Persistence of Coastal Cities”. In: *Working Paper*. URL: [https://economics.mit.edu/sites/default/files/publications/Catastrophe\\_Risk\\_and\\_Settlement\\_Location.pdf](https://economics.mit.edu/sites/default/files/publications/Catastrophe_Risk_and_Settlement_Location.pdf).
-  Balboni, Clare et al. (2020). “Transportation, Gentrification, and Urban Mobility: The Inequality Effects of Place-Based Policies”. In: *Working Paper*. URL: [http://stanford.edu/~memorten/ewExternalFiles/CCMS\\_TZ.pdf](http://stanford.edu/~memorten/ewExternalFiles/CCMS_TZ.pdf).
-  Baldomero-Quintana, Luis (2022). “How Infrastructure Shapes Comparative Advantage”. In: *Working paper, mimeo*.

## References IV

-  Banerjee, Abhijit, Esther Duflo, and Nancy Qian (2020). “On the Road: Access to Transportation Infrastructure and Economic Growth in China”. In: *Journal of Development Economics* 145, p. 102442. DOI: [10.1016/j.jdeveco.2020.102442](https://doi.org/10.1016/j.jdeveco.2020.102442). (Visited on 05/31/2023).
-  Barwick, Panle Jia et al. (2022). “Improved Transportation Networks Facilitate Adaptation to Pollution and Temperature Extremes”. In: *NBER Working Paper* 30462.
-  Bird, Julia, Mathilde Lebrand, and Anthony J. Venables (2020). “The Belt and Road Initiative: Reshaping Economic Geography in Central Asia?” en. In: *Journal of Development Economics* 144, p. 102441. ISSN: 0304-3878. DOI: [10.1016/j.jdeveco.2020.102441](https://doi.org/10.1016/j.jdeveco.2020.102441). URL: <https://www.sciencedirect.com/science/article/pii/S030438782030016X> (visited on 06/05/2023).
-  Bluhm, Richard et al. (2023). “Connective Financing: Chinese Infrastructure Projects and the Diffusion of Economic Activity in Developing Countries”. In: *CEPR Working Paper* 14818.

## References V

-  Bogart, Dan and Latika Chaudhary (2012). “Regulation, Ownership, and Costs: A Historical Perspective from Indian Railways”. en. In: *American Economic Journal: Economic Policy* 4.1, pp. 28–57. ISSN: 1945-7731. DOI: 10.1257/pol.4.1.28. URL: <https://www.aeaweb.org/articles?id=10.1257/pol.4.1.28> (visited on 06/23/2023).
-  Bonfatti, Roberto and Steven Poelhekke (2017). “From Mine to Coast: Transport Infrastructure and the Direction of Trade in Developing Countries”. en. In: *Journal of Development Economics* 127, pp. 91–108. ISSN: 0304-3878. DOI: 10.1016/j.jdeveco.2017.03.004. URL: <https://www.sciencedirect.com/science/article/pii/S0304387817300287> (visited on 06/23/2023).
-  Bonilla-Mejía, L and J Morales (2023). “Jam-Barrel Politics”. In: *Review of Economics and Statistics* forthcoming.
-  Brooks, Wyatt and Kevin Donovan (2020). “Eliminating Uncertainty in Market Access: The Impact of New Bridges in Rural Nicaragua”. In: *Econometrica* 88.5, pp. 1965–1997. DOI: <https://doi.org/10.3982/ECTA15828>. URL: <https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA15828>.

## References VI


-  Burgess, Robin et al. (2015). “The Value of Democracy: Evidence from Road Building in Kenya”. en-US. In: *American Economic Review* 105.6, pp. 1817–1851. URL: <http://emiguel.econ.berkeley.edu/research/the-value-of-democracy-evidence-from-road-building-in-kenya/> (visited on 06/20/2023).
-  Chen, Qianmiao (2023). “Corruption in Procurement Auctions: Evidence from Collusion between Officers and Firms”. In: *Working Paper*.
-  Collier, Paul, Martina Kirchberger, and Måns Söderbom (2016). “The Cost of Road Infrastructure in Low- and Middle-Income Countries”. In: *The World Bank Economic Review* 30.3, pp. 522–548. ISSN: 0258-6770. DOI: [10.1093/wber/lhv037](https://doi.org/10.1093/wber/lhv037).
-  Conwell, Lucas (2023). “Are There Too Many Minibuses in Cape Town? Privatized Provision of Public Transit”. In: *Working Paper*.
-  Coşar, Kerem (2022). “Overland Transport Costs, a Review”. In: *World Bank Policy Research Working Paper 10156*.








## References VII

-  Coşar, Kerem and Banu Demir (2016). “Domestic Road Infrastructure and International Trade: Evidence from Turkey”. en. In: *Journal of Development Economics* 118, pp. 232–244. ISSN: 0304-3878. DOI: 10.1016/j.jdeveco.2015.10.001. URL: <https://www.sciencedirect.com/science/article/pii/S0304387815001121> (visited on 06/05/2023).
-  Datta, Saugato (2012). “The Impact of Improved Highways on Indian Firms”. en. In: *Journal of Development Economics* 99.1, pp. 46–57. ISSN: 0304-3878. DOI: 10.1016/j.jdeveco.2011.08.005. URL: <https://www.sciencedirect.com/science/article/pii/S0304387811000861> (visited on 06/23/2023).
-  Davis, Lucas (2008). “The Effect of Driving Restrictions on Air Quality in Mexico City”. In: *Journal of Political Economy* 116.1, pp. 38–81. DOI: 10.1086/529398. URL: <https://www.journals.uchicago.edu/doi/10.1086/529398> (visited on 05/31/2023).



## References VIII

-  Donaldson, Dave (2018). “Railroads of the Raj: Estimating the Impact of Transportation Infrastructure”. en. In: *American Economic Review* 108.4-5, pp. 899–934. ISSN: 0002-8282. DOI: [10.1257/aer.20101199](https://doi.org/10.1257/aer.20101199). URL: <https://www.aeaweb.org/articles?id=10.1257/aer.20101199> (visited on 05/31/2023).
-  Donaldson, Dave and Richard Hornbeck (2016). “Railroads and American Economic Growth: A “Market Access” Approach”. In: *The Quarterly Journal of Economics* 131.2, pp. 799–858. ISSN: 0033-5533. DOI: [10.1093/qje/qjw002](https://doi.org/10.1093/qje/qjw002). URL: <https://doi.org/10.1093/qje/qjw002> (visited on 05/31/2023).
-  Faber, Benjamin (2014). “Trade Integration, Market Size, and Industrialization: Evidence from China’s National Trunk Highway System”. In: *Review of Economic Studies* 81.3, pp. 1046–1070. DOI: [10.1093/restud/rdu010](https://doi.org/10.1093/restud/rdu010). (Visited on 05/31/2023).
-  Fabre, Anaïs and Stéphane Straub (2023). “The Impact of Public–Private Partnerships (PPPs) in Infrastructure, Health, and Education”. en. In: *Journal of Economic Literature* 61.2, pp. 655–715. ISSN: 0022-0515. DOI: [10.1257/jel.20211607](https://doi.org/10.1257/jel.20211607). URL: <https://www.aeaweb.org/articles?id=10.1257/jel.20211607> (visited on 06/23/2023).

## References IX

-  Fan, Jingting, Lu Ti, and Wenlan Luo (2023). “Valuing Domestic Transport Infrastructure: A View from the Route Choice of Exporters”. In: *Review of Economics and Statistics* 105.6, pp. 1562–1579.
-  Fenske, J, N Kala, and J Wei (2023). “Railways and Cities in India”. In: *Journal of Development Economics* 161.
-  Fogel, Robert W. (1964). *Railroads and American Economic Growth: Essays in Econometric History*. Johns Hopkins University Press.
-  Foster, Vivien and Cecilia Briceno-Garmendia (2010). *Africa’s Infrastructure : A Time for Transformation*. World Bank. ISBN: 978-0-8213-8041-3. DOI: [10.1596/978-0-8213-8041-3](https://hdl.handle.net/10986/2692). URL: <http://hdl.handle.net/10986/2692> (visited on 06/05/2023).
-  Gaduh, Arya, Tadeja Gračner, and Alexander Rothenberg (2022). “Life in the Slow Lane: Unintended Consequences of Public Transit in Jakarta”. In: *Journal of Urban Economics* 128.





## References X

-  Garcia-Lopez, Miguel-Angel, Adelheid Holl, and Elisabet Viladecans-Marsal (2015). “Suburbanization and Highways in Spain when the Romans and the Bourbons Still Shape its Cities”. In: *Journal of Urban Economics* 85, pp. 52–67. DOI: 10.1016/j.jue.2014.11.002. URL: <https://www.sciencedirect.com/science/article/abs/pii/S0094119014000953> (visited on 05/31/2023).
-  Gebresilasse, Mesay (2023). “Rural Roads, Agricultural Extension, and Productivity”. en. In: *Journal of Development Economics* 162, p. 103048. ISSN: 0304-3878. DOI: 10.1016/j.jdeveco.2023.103048. URL: <https://www.sciencedirect.com/science/article/pii/S0304387823000032> (visited on 06/05/2023).
-  Gendron-Carrier, Nicolas et al. (2022). “Subways and Urban Air Pollution”. en. In: *American Economic Journal: Applied Economics* 14.1, pp. 164–196. ISSN: 1945-7782. DOI: 10.1257/app.20180168. URL: <https://www.aeaweb.org/articles?id=10.1257/app.20180168> (visited on 05/31/2023).
-  Gertler, Paul et al. (2019). “Road Quality, Local Economic Activity, and Welfare: Evidence from Indonesia’s Highways”. In: *NBER Working Paper 30454*.

## References XI

-  Ghani, Ejaz, Arti Grover Goswami, and William Kerr (2016). “Highway to Success: The Impact of the Golden Quadrilateral Project for the Location and Performance of Indian Manufacturing”. In: *The Economic Journal* 126.591, pp. 317–357. DOI: [10.1111/eoj.12207](https://doi.org/10.1111/eoj.12207). URL: <https://onlinelibrary.wiley.com/doi/full/10.1111/eoj.12207> (visited on 05/31/2023).
-  Gonzalez-Navarro, Marco and Climent Quintana-Domeque (2016). “Paving Streets for the Poor: Experimental Analysis of Infrastructure Effects”. In: *Review of Economics and Statistics* 98.2, pp. 254–267. URL: <https://direct.mit.edu/rest/article-abstract/98/2/254/58333/Paving-Streets-for-the-Poor-Experimental-Analysis?redirectedFrom=fulltext> (visited on 05/31/2023).
-  Gonzalez-Navarro, Marco and Matthew A. Turner (2018). “Subways and Urban Growth: Evidence from Earth”. In: *Journal of Urban Economics* 108, pp. 85–106. URL: <https://www.sciencedirect.com/science/article/abs/pii/S009411901830072X> (visited on 05/31/2023).
-  Gu, Yizhen et al. (2021). “Subways and Road Congestion”. In: *American Economic Journal: Applied Economics* 13.2, pp. 83–115.





## References XII

-  Habyarimana, J and J William (2015). “Results of a Large-Scale Randomized Behavior Change Intervention on Road Safety in Kenya”. In: *Proceedings of the National Academy of Science* 112.34.
-  Hanna, Rema, Gabriel Kreindler, and Benjamin A Olken (2017). “Citywide Effects of High-Occupancy Vehicle Restrictions: Evidence from “Three-in-One” in Jakarta”. In: *Science* 357.6346, pp. 89–93. URL: <https://www.science.org/doi/10.1126/science.aan2747> (visited on 06/26/2023).
-  Iimi, Atsushi et al. (2019). “Port Rail Connectivity and Agricultural Production: Evidence from a Large Sample of Farmers in Ethiopia”. In: *Journal of Applied Economics* 22.1, pp. 152–173. ISSN: 1514-0326. DOI: [10.1080/15140326.2019.1591814](https://doi.org/10.1080/15140326.2019.1591814). URL: <https://doi.org/10.1080/15140326.2019.1591814> (visited on 06/05/2023).
-  Jedwab, Remi, Edward Kerby, and Alexander Moradi (2017). “History, Path Dependence and Development: Evidence from Colonial Railways, Settlers and Cities in Kenya”. In: *The Economic Journal* 127.603, pp. 1467–1494. DOI: <https://doi.org/10.1111/eoj.12347>. URL: <https://onlinelibrary.wiley.com/doi/abs/10.1111/eoj.12347>.

## References XIII





-  Jedwab, Remi and Alexander Moradi (2016). “The Permanent Effects of Transportation Revolutions in Poor Countries: Evidence from Africa”. In: *The Review of Economics and Statistics* 98, pp. 268–284. DOI: [10.1162/REST\\_a\\_00540](https://doi.org/10.1162/REST_a_00540). (Visited on 05/31/2023).
-  Jedwab, Rémi and Adam Storeygard (2022). “The Average and Heterogeneous Effects of Transportation Investments: Evidence from Sub-Saharan Africa 1960–2010”. In: *Journal of the European Economic Association* 20.1, pp. 1–38. URL: <https://academic.oup.com/jeea/article/20/1/1/6302382>.
-  Khanna, Gaurav et al. (2022). “Spatial Mobility, Economic Opportunity, and Crime”. In: *Working Paper*.
-  Koh, Yumi, Jing Li, and Jianhuan Xu (2023). “Subway, Collaborative Matching, and Innovation”. In: *The Review of Economics and Statistics*.
-  Kreindler, Gabriel (2022). “Peak-Hour Road Congestion Pricing: Experimental Evidence and Equilibrium Implications”. In: *Working Paper*. URL: [https://raw.githubusercontent.com/Gkreindler/personal-website/default/paper-cp-bangalore/Kreindler%20\(2022\)%20paper%20and%20appendix%2010-09.pdf](https://raw.githubusercontent.com/Gkreindler/personal-website/default/paper-cp-bangalore/Kreindler%20(2022)%20paper%20and%20appendix%2010-09.pdf).

## References XIV




-  Kreindler, Gabriel et al. (2023). “Optimal Public Transportation Networks: Evidence from the World’s Largest Bus Rapid Transit System in Jakarta”. In: *Working Paper*. URL: <https://drive.google.com/file/d/1BeIrHvZOFsG30c672oG9FAqX8s82lnA0/view>.
-  Lall, Somik et al. (2021). “Pancakes to Pyramids: City Form to Promote Sustainable Growth”. In: *World Bank Report*.
-  Lall, Somik V. and Mathilde Lebrand (2020). “Who Wins, Who Loses? Understanding the Spatially Differentiated Effects of the Belt and Road Initiative”. In: *Journal of Development Economics* 146, p. 102496. ISSN: 0304-3878. DOI: <https://doi.org/10.1016/j.jdeveco.2020.102496>. URL: <https://www.sciencedirect.com/science/article/pii/S0304387820300717>.
-  Lehne, Jonathan, Jacob N. Shapiro, and Oliver Vanden Eynde (2018). “Building Connections: Political Corruption and Road Construction in India”. In: *Journal of Development Economics* 131, pp. 62–78. ISSN: 0304-3878. DOI: [10.1016/j.jdeveco.2017.10.009](https://doi.org/10.1016/j.jdeveco.2017.10.009). URL: <https://www.sciencedirect.com/science/article/pii/S0304387817300883> (visited on 06/21/2023).



## References XV

-  Lewis-Faupel, Sean et al. (2016). “Can Electronic Procurement Improve Infrastructure Provision? Evidence from Public Works in India and Indonesia”. en. In: *American Economic Journal: Economic Policy* 8.3, pp. 258–283. ISSN: 1945-7731. DOI: [10.1257/pol.20140258](https://doi.org/10.1257/pol.20140258). URL: <https://www.aeaweb.org/articles?id=10.1257/pol.20140258> (visited on 06/21/2023).
-  Martincus, Christian Volpe, Jeronimo Carballo, and Ana Cusolito (2017). “Roads, Exports and Employment: Evidence from a Developing Country”. In: *Journal of Development Economics* 125, pp. 21–39. DOI: [10.1016/j.jdeveco.2016.10.002](https://doi.org/10.1016/j.jdeveco.2016.10.002). (Visited on 05/31/2023).
-  McFadden, Daniel (1974). “Conditional Logit Analysis of Qualitative Choice Behavior”. en. In: *Frontiers in Econometrics*. Ed. by Paul Zarembka. New York: Academic Press, pp. 105–142.
-  Meijer, Johan R. et al. (2018). “Global Patterns of Current and Future Road Infrastructure”. en. In: *Environmental Research Letters* 13.6, p. 064006. ISSN: 1748-9326. DOI: [10.1088/1748-9326/aabd42](https://doi.org/10.1088/1748-9326/aabd42). URL: <https://dx.doi.org/10.1088/1748-9326/aabd42> (visited on 06/15/2023).






## References XVI

-  Mesquita Moriera, Mauricio et al. (2013). *Too Far to Export: Domestic Transport Costs and Regional Export Disparities in Latin America and the Caribbean*. Inter-American Development Bank. URL: <https://publications.iadb.org/en/publication/17434/too-far-export-domestic-transport-costs-and-regional-export-disparities-latin> (visited on 06/05/2023).
-  Mitnik, Oscar A., Raul Sanchez, and Patricia Yañez (2018). “Bright Investments: Measuring the Impact of Transport Infrastructure Using Luminosity Data in Haiti”. English. In: *Inter-American Development Bank Working Paper 935*. DOI: 10.18235/0001474. URL: <https://publications.iadb.org/en/bright-investments-measuring-impact-transport-infrastructure-using-luminosity-data-haiti> (visited on 06/05/2023).
-  Morten, Melanie and Jaqueline Oliviera (2023). “The Effects of Roads on Trade and Migration: Evidence from a Planned Capital City”. In: *Working Paper*.

## References XVII

-  Oliva, Paulina (2015). “Environmental Regulations and Corruption: Automobile Emissions in Mexico City”. In: *Journal of Political Economy* 123.3, pp. 686–724. ISSN: 0022-3808. DOI: [10.1086/680936](https://doi.org/10.1086/680936). URL: <https://www.journals.uchicago.edu/doi/abs/10.1086/680936> (visited on 05/31/2023).
-  Olken, Benjamin A and Rohini Pande (2012). “Corruption in Developing Countries”. In: *Annual Review of Economics* 4, pp. 479–509. DOI: [10.1146/annurev-economics-080511-110917](https://doi.org/10.1146/annurev-economics-080511-110917).
-  Olken, Benjamin A. (2007). “Monitoring Corruption: Evidence from a Field Experiment in Indonesia”. In: *Journal of Political Economy* 115.2, pp. 200–249. ISSN: 0022-3808. DOI: [10.1086/517935](https://doi.org/10.1086/517935). URL: <https://www.journals.uchicago.edu/doi/10.1086/517935> (visited on 06/20/2023).
-  Osborne, Theresa, Maria Caudia Pachón, and Gonzalo Enrique Araya (2014). “What Drives the High Price of Road Freight Transport in Central America?” In: *World Bank Policy Research Working Paper 6844*.
-  Pellegrina, Heitor and Sebastian Sotelo (2023). “Migration, Specialization, and Trade: Evidence from Brazil’s March to the West”. In: *Working Paper*.

## References XVIII

-  Porteous, Obie (2019). “High Trade Costs and Their Consequences: An Estimated Dynamic Model of African Agricultural Storage and Trade”. en. In: *American Economic Journal: Applied Economics* 11.4, pp. 327–366. ISSN: 1945-7782. DOI: [10.1257/app.20170442](https://doi.org/10.1257/app.20170442). URL: <https://www.aeaweb.org/articles?id=10.1257/app.20170442> (visited on 06/23/2023).
-  Redding, Stephen J. and Esteban Rossi-Hansberg (2017). “Quantitative Spatial Economics”. In: *Annual Review of Economics* 9.1, pp. 21–58. DOI: [10.1146/annurev-economics](https://doi.org/10.1146/annurev-economics.2017.09.01.11). URL: <https://ideas.repec.org/a/anr/reveco/v9y2017p21-58.html>.
-  Remi Jedwab, Gabriel Ahlfeldt and Nathaniel Baum-Snow (2023). “The Global Economic and Environmental Effects of Vertical Urban Development”. In: *Working Paper*.
-  Rhotenberg, Alex and Jingxuan Du (2023). “The Benefits and Costs of Motorization: Evidence from Jakarta”. In: *Working Paper*.
-  Shamdasani, Yogita (2021). “Rural road infrastructure & agricultural production: Evidence from India”. en. In: *Journal of Development Economics* 152, p. 102686. ISSN: 0304-3878. DOI: [10.1016/j.jdeveco.2021.102686](https://doi.org/10.1016/j.jdeveco.2021.102686). URL: <https://www.sciencedirect.com/science/article/pii/S0304387821000638> (visited on 06/05/2023).

## References XIX

-  Sotelo, Sebastian (2020). “Domestic Trade Frictions and Agriculture”. In: *Journal of Political Economy* 128.7, pp. 2690–2738.
-  Suzuki, H. et al. (2015). *Financing Transit-Oriented Development with Land Values: Adapting Land Value Capture in Developing Countries*. Urban Development Series, World Bank.
-  Tian, Lin and Yue Yu (2023). “Geographic Integration and Firm Exports: Evidence from China”. In: *Working Paper*.
-  Trebilcock, Michael and Michael Rosenstock (2015). “Infrastructure Public–Private Partnerships in the Developing World: Lessons from Recent Experience”. In: *The Journal of Development Studies* 51.4, pp. 335–354. ISSN: 0022-0388. DOI: [10.1080/00220388.2014.959935](https://doi.org/10.1080/00220388.2014.959935). (Visited on 06/23/2023).
-  Tsivanidis, Nick (2022). “Evaluating the Impact of Urban Transit Infrastructure: Evidence from Bogotá’s TransMilenio”. In: *Working Paper*.
-  Warnes, Pablo E. (2021). “Transport Infrastructure Improvements and Spatial Sorting: Evidence from Buenos Aires”. In: *Working Paper*.
-  Zarate, Roman (2023). “Spatial Misallocation, Informality, and Transit Improvements: Evidence from Mexico City”. In: *World Bank Policy Research Working Paper 9990*. URL: [https://www.romandavidzarate.com/\\_files/ugd/0794ab\\_705be92077a24a3e876da376a50288d5.pdf](https://www.romandavidzarate.com/_files/ugd/0794ab_705be92077a24a3e876da376a50288d5.pdf).