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Topic 23: Donaldson, D., and R. Hornbeck, 2016. Railroads and American Economic Growth: a 'Market Access' Approach, Quarterly Journal of Economics 131(2), 799-858

Essay 1: Critical Reading of the Paper

Part I: Executive Summary

A) Introduction

In "Railroads and American Economic Growth: a 'Market Access' Approach", Donaldson and Hornbeck revisit the seminal question posed by Robert Fogel in "Railroads and American Economic Growth" (1964): what was the economic contribution of railroads to 19th-century U.S. development? Departing from Fogel's "social savings" approach, the authors instead adopt a "market access" framework derived from spatial general equilibrium trade theory. Their innovation lies in quantifying how changes in trade costs, induced by railroad expansion between 1870 and 1890, affected county-level agricultural land values via shifts in general equilibrium market access. Thus, they draw on Eaton and Kortum (2002) to define market access as a county's access to other counties' markets weighted by population and adjusted for trade costs, capturing a location's trade potential.

To implement their framework, the authors construct a comprehensive GIS-based network of railroads and waterways in late 19th-century U.S. and compute lowest-cost freight routes between counties. These cost-minimizing routes are then used to derive a theoretically grounded measure of each county's market access and estimate the aggregate impact of railroad expansion. In other words, they seek to go beyond Fogel's approach to capture both direct and indirect spillover effects of infrastructure improvements and measure how these improvements affected the American economy. Overall, the paper demonstrates that the expansion of the railroad network between 1870 and 1890 substantially increased counties' market access and that these increases were strongly capitalized into higher agricultural land values. Finally, the authors run a series of counterfactual simulations in which they estimate the effect of removing all railroads from the 1890 U.S. network on the total value of agricultural land. They find that the mitigation effects of extending canals or improving wagon infrastructure would only have been limited, confirming the key role of the railroad network in shaping the 19th-century U.S. economic landscape.

B) Research Question and Intuition

Beyond studying the impact of the railroad network expansion on the American economy, the paper addresses a core methodological issue in spatial economics and economic history: how can we estimate the aggregate effect of place-based infrastructure investments, like the 19th-century U.S. railroad network, when such interventions generate extensive general equilibrium spillovers beyond directly treated units?

While much of the early historical literature presumed railroads were key to U.S. development, this assumption began to face quantitative scrutiny with Fogel's "social saving" methodology. In Fogel (1964), the author proposed to estimate the "social saving" of railroads by comparing freight costs across modes for selected routes, an approach that would become dominant in the historical literature. By focusing on counterfactual, the author argued that in the absence of railroads, river and canal transportation could have substituted effectively along most major freight routes. From this, he concludes that the aggregate impact of railroads on the agricultural sector was modest. However, this approach relied on strong assumptions, such as fixed quantities and locations. In that sense, it has been criticized for overlooking how infrastructure transforms broader trade patterns, land use, and regional productivity. Indeed, as David (1969) and Lebergott (1966) noted, such methods may miss the broader spatial reorganization and overlook spillovers.

Donaldson and Hornbeck maintain Fogel's focus on the agricultural sector and build on his intuition that the value of agricultural land, as an immobile factor, reflects the costs of getting agricultural goods to market. However, they introduce the concept of market access, a reduced-form expression derived from structural trade models (e.g., Eaton and Kortum, 2002), as a sufficient statistic to capture the total exposure of a county to changes in the transportation network. The logic is that improvements in market access reduce the cost to reach other markets, and raise the net revenue from agricultural production, which is then capitalized into land values. Indeed, trade infrastructure affects not only the cost of shipping existing goods but also which markets an area can profitably serve. When a county gains access to more or larger markets at lower cost, its products fetch higher net prices, which raises land demand and value. Hence, by measuring how expansion in the railroad network affected counties' market access, the authors infer both direct and direct effect of railroads on economic development and welfare.

C) Empirical Challenge: Methodology and Results

A key empirical challenge that arises comes from the spatially diffuse nature of the treatment: railroads may affect all counties, either directly or indirectly, through interlinked trade network-induced changes in accessibility. This raises concerns about identification, measurement error, and attenuation bias if one were to use local railroad presence only as the treatment variable. As a result, the authors needed to implement a framework to estimate aggregate treatment effects in an empirical setting with important treatment spillover effects.

To address this issue, Donaldson and Hornbeck construct a detailed geographic information system (GIS)-based network database encompassing all navigable waterways, canals, railroads, and major wagon routes in the contiguous United States in 1870 and 1890. Freight costs are assigned to each mode of transportation using parameters from Fogel, enabling computation of minimum-cost freight routes between all county pairs. These data are combined with digitized county-level information on agricultural land values and population from the U.S. Censuses of Agriculture and Population. The logic is that increased access to markets raises the marginal value of output, and in a competitive land market, this is capitalized into higher land prices. The key explanatory variable is a county's market access, computed as a weighted sum of other counties' populations, inversely weighted by bilateral trade costs, derived from gravity-based trade models (Eaton and Kortum, 2002). By doing so, the authors aim to capture the ease with which a county can trade with other markets. Estimations are conducted using both OLS and IV strategies, with historical waterway access as an instrument for market access.

The empirical results suggest that increases in market access between 1870 and 1890 are capitalized into substantially higher agricultural land values. The elasticity of land value with respect to market access is estimated to lie between 0.3 and 0.5. Note these estimates are robust to restricting identification to distant market access, excluding own-county railroad tracks, and varying instrument specifications.

The perks of this methodology lie in its alignment with general equilibrium trade theory, while the model maintains the framework underlying Fogel's "social saving" approach. Instead of estimating reduced-form effects of local railroad density, which may be endogenous or mismeasured, the authors estimate the aggregate impact of "market access", so each county is influenced by changes elsewhere in the network. Moreover, by calculating lowest-cost county-to-county freight routes, the authors avoid relying on "shortest path" estimates that could be misleading. Overall, this paper constitutes a significant methodological and empirical advancement in the economic history of American infrastructure.

D) Counterfactual Simulations

The other important contribution of the paper lies in its counterfactual analysis. Using the estimated elasticity and the structural relationship between trade costs and market access, the authors simulate the impact of removing the railroad network in 1890. In the baseline scenario, under a fixed population distribution, eliminating railroads reduces total agricultural land value by 60.2%, equivalent to 3.22% of GNP. This stands in contrast to Fogel's estimate of 2.7%, which considered only direct freight savings along select routes. The intuition is that railroads enabled spatial reallocation of production and expanded market access nationwide, not just along a few high-volume corridors.

To test the robustness of these findings, the authors relax several assumptions. First, they vary the counterfactual population distribution using historical values from 1830, 1850, and 1870, finding little difference in aggregate losses. Second, they solve for the counterfactual equilibrium population allocation endogenously, holding total U.S. population fixed. The main results remain unchanged, suggesting the effects are not driven solely by static location assumptions.

They also examine scenarios with endogenous utility. Holding total population fixed but allowing worker utility to fall in the absence of railroads, land values fall by less, but the total economic loss remains large. These results emphasize that land values may only partially reflect the broader welfare consequences of transportation infrastructure. In both cases, the counterfactual effects on population and welfare reflect additional aggregate losses from removing railroads, which neither the baseline estimates nor Fogel's estimates, based on losses in agricultural land value only, take into account.

Finally, the authors explore whether alternative transportation investments could have substituted for railroads. They find that Fogel's proposed canal extensions would have mitigated only 13% of the losses, and lower wagon transportation costs only 21%. Even these partial gains would have required enormous investments and would not have matched the spatial coverage or cost-efficiency of railroads. Moreover, in the absence of railroads, waterway congestion could have increased, amplifying losses (Holmes and Schmitz 2001).

E) Contributions

This paper contributes to the literature through both its findings and approach. In economic history, it provides a major revision of one of the field's canonical estimates, demonstrating that the aggregate effects of railroads were much larger than previously thought. By grounding the analysis in general equilibrium trade theory and using historical data in a spatially explicit framework, the authors address critiques of the social saving methodology (David, 1969; Lebergott, 1966). In spatial economics, the paper operationalizes the concept of market access as a sufficient statistic for regional economic potential, providing empirical validation for theoretical models in the New Economic Geography tradition (Krugman, 1991; Redding and Venables, 2004). The results confirm that trade cost reductions reconfigure spatial equilibria in ways that go far beyond direct freight savings. The paper also contributes to the empirical toolkit for evaluating infrastructure by showing how to integrate structural trade models with GIS transport data and land value outcomes. This approach is widely applicable to contemporary settings, from highway systems to digital infrastructure.

In sum, Donaldson and Hornbeck (2016) offer a foundational analysis of the aggregate effects of transportation infrastructure, by proposing a methodology for empirical spatial works, in both historical and modern contexts.

Part II: Comparative Approach

In this section, we discuss how the findings and methodology of Donaldson and Hornbeck (2016) relate to the broader literature in urban, regional, and spatial economics, both from an empirical and a theoretical perspective. The paper hinges on three fundamental concepts -trade costs, market access, and agricultural land value- and explores how their interaction drives regional economic transformation. It provides a rigorous analysis of how declining trade costs, driven by transportation network expansion, alter market access and reshape the spatial economy through changes in land values.

A) Falling Trade Costs and Land Use

Trade costs, broadly defined, refer to any extra costs incurred when selling in a location different from where production occurs. These include transportation costs, information frictions, and trade policy barriers. Donaldson and Hornbeck focus explicitly on the first component and how its fall affected 19th-century America economy.

Historically, trade costs have declined dramatically over the past two centuries, a trend extensively documented in the literature. Bairoch (1989), for instance, shows that the share of transport costs in the final price of goods such as wheat, bar iron, cotton thread, and textiles fell significantly between 1830 and 1910. This decline is precisely the phenomenon Donaldson and Hornbeck study in the context of U.S. railroads: the impact of falling transportation costs for agricultural goods in remote areas.

In the urban economics literature, the monocentric city model interprets falling transportation costs as falling commuting costs. In the standard model (without constraint), lower commuting costs then translate into urban expansion and higher land prices at the former urban fringe, due to relaxed spatial constraints on labor mobility. However, this logic does not seem to apply to the setting studied by Donaldson and Hornbeck. Indeed, the 19th-century railroad system was primarily designed to reduce the cost of shipping goods, not people, as the authors point out; “the effect of railroads was mainly to reduce distances of expensive wagon transportation”. Thus, the increase in land values observed in their study is not the result of pressure along the bid-rent curve in agricultural areas, but rather a result of expanded “market access” for peripheral regions. Moreover, their framework does not model changes in land use (e.g. urban, rural), we will delve more into this aspect in the second essay.

Hence, the focus of the paper is not on within-city dynamics but on how remote agricultural counties, beyond the urban fringe, were transformed by improved access to distant markets. The land price increases are here attributed to expanded trade opportunities and the revaluation of economic geography, rather than urbanization or density effects.

B) Market Access and the NEG Framework

Drawing on Eaton and Kortum (2002) and Fujita, Krugman, and Venables (1999), Donaldson and Hornbeck define "market access" using a structural gravity model grounded in the trade literature. Their definition captures both local and network-wide effects of infrastructure on a county's ability to engage in trade, not only through direct connection, but indirect effect via the network. Hence, market access becomes a weighted sum of other counties' economic size, with weights declining in bilateral trade costs. The novelty lies in their empirically grounded construction of this measure using historical GIS data and transport cost estimates, avoiding the use of geographic or Euclidean proxies for distance.

In the New Economic Geography (NEG) framework, first articulated by Krugman (1991), a firm's "market potential" is defined as the spatially discounted sum of demand across all locations. This spatial discount factor ϕ corresponds to the "freeness" of trade: $\phi = \tau - (\sigma - 1)$, which increases as trade costs τ fall. Accordingly, the expansion of the railroad network in Donaldson and Hornbeck increases the effective "freeness" of trade between counties, raising their market potential. The paper essentially switch the focus from the firm in Krugman's model to the county, showing how improved trade linkages due to railroads raise economic value as proxied by land prices.

NEG models also suggest that trade costs are a central determinant of spatial disparities, especially across different phases of integration. Before the railroad boom, trade costs over land were prohibitively high. Most counties depended on waterways and rudimentary roads, leaving interior regions economically isolated. Railroads sharply reduced these costs, allowing such areas to connect with distant, densely populated markets. Donaldson and Hornbeck empirically document this phase transition: from a fragmented, high-cost economy toward a more integrated spatial structure.

Overall, their findings provide clear evidence of spatial integration via market access. Land values increased most in counties where trade costs declined the most, consistent with the NEG prediction that reductions in iceberg trade costs contribute to economic development in newly accessible regions; this could be understood as the "convergence" phase of the NEG Bell-Shaped effect. In Donaldson and Hornbeck's framework, land values act as proxies for location-specific welfare or productivity, akin to wages or utility in traditional urban model, offering an alternative lens on the formation of core-periphery structures.

Finally, the paper's counterfactual simulations illustrate the essential role of trade costs in shaping spatial equilibria. Removing the railroad network effectively reverses the phase transition, pushing the economy back to a dispersed, high-cost configuration. In this scenario, land values collapse, especially in interior and non-coastal regions. The authors show that alternative investments in canals or roads would not have reached the cost-reduction threshold necessary to trigger full spatial integration, confirming the railroad system's role as a phase-shifting technology in economic geography.

C) NEG Extensions: Land use and trade costs in agriculture

The standard New Economic Geography (NEG) framework, as derived from Krugman (1991), provides a powerful account of how increasing returns to scale, trade costs, and factor mobility shape spatial economic outcomes. However, this baseline model includes several simplifying assumptions that limit its applicability to rural and agricultural settings; the most important in this context is zero trade cost on agricultural goods. Altogether, this assumption is not suited to explaining spatial dynamics in economies where agriculture remains a major sector and where land use and agricultural trade costs are spatially heterogeneous and important, like 19th-century American countryside. In this section, we discuss two extensions that try to address these shortcomings, related to Donaldson and Hornbeck (2016) findings: Picard and Zeng (2005) and Puga (1999), focusing respectively on trade costs and land use in agriculture, both providing a rationale for further dispersion forces.

Picard and Zeng (2005) extend the NEG framework by introducing agricultural trade costs as a key structural friction in spatial equilibrium. By relaxing the standard assumption of costless trade in agricultural goods, they show how transport frictions can create persistent regional inequalities, making peripheral areas appear unproductive when they are in fact under-connected. This introduces a powerful dispersion force: improvements in agricultural connectivity reduce trade costs, help interior regions become more competitive, and mitigate the tendency toward industrial agglomeration.

Their key insight is that when agricultural trade costs are high, rural regions suffer from lower wages and declining competitiveness, making them unattractive for manufacturing firms. But as agricultural trade costs fall, through improvements in transport infrastructure or connectivity, interior regions become more economically viable, encouraging the dispersion of industrial activity. In this way, agriculture itself becomes a source of spatial dispersion, moderating the core-periphery outcome emphasized in standard NEG. This theoretical result closely mirrors the empirical mechanism documented in Donaldson and Hornbeck (2016): railroads lowered agricultural trade costs and enhanced rural market access, which was here capitalized into higher land values. While Picard and Zeng focus on the resulting shifts in wage structures and firm locations, Donaldson and Hornbeck measure how these general equilibrium forces affect the value of land as a fixed production factor. Both studies affirm that spatial frictions in agriculture play a critical role in determining equilibrium location outcomes, and both demonstrate that connectivity in the agricultural sector can be a key lever for achieving more balanced spatial development. Thus, it would be interesting to see if Picard's and Zeng's predictions on manufacturing spatial allocation holds in the context 19^{th}-century American railway network expansion.

Finally, Puga (1999) extends the NEG framework by putting the emphasis on the non-monotonic relationship between trade costs and the spatial concentration, allowing for both agglomeration and re-dispersion as trade costs fall. A key feature of his two sectors-model is that arable land is a fixed, immobile factor in agricultural production. Agriculture, using land and labor under constant returns to scale, introduces spatial immobility and heterogeneity into the equilibrium. Although agricultural goods are traded without cost in the model, landowners consume locally, and differences in land endowment and wages create variation in agricultural returns. This structure ensures that agricultural regions maintain economic mass even when manufacturing activity centralizes, providing a spatial anchor that moderates full agglomeration.

Within this framework, Puga identifies three distinct phases of spatial equilibrium in response to falling trade costs: at high trade costs, economic activity remains dispersed to meet local demand; at intermediate levels, agglomeration emerges due to increasing returns and market-size effects; and at very low trade costs, re-dispersion sets in as cost sensitivities, immobile inputs, and congestion reduce the relative advantages of centralization.

While Puga's model is theoretical and abstracts from agricultural trade costs, it offers a compelling conceptual lens through which to interpret the findings of Donaldson and Hornbeck (2016). Their analysis can be viewed as an empirical application of Puga's framework to the historical U.S. setting. The paper's counterfactuals mirror the phases identified by Puga: before the railroad expansion, the U.S. was in a high trade cost and spatially dispersed phase. The arrival of railroads shifted the country into the intermediate trade cost phase, marked by spatial integration and gains from agglomeration through improved access to markets. The authors also simulate the removal of the railroad network, finding a sharp collapse in agricultural land values and a return to economic dispersion, which replicates Puga's low-access, high-cost equilibrium. Thus, like Puga, Donaldson and Hornbeck emphasize that infrastructure investments fundamentally alter the "economic geography phase" of a country and that changes in market access can reorganize the spatial distribution of productivity and welfare.

Essay 2: Research Project

Part I: Limitations

A) *Over-reliance on Market Access as a sufficient statistic*

Donaldson and Hornbeck (2016) anchor their empirical strategy on a core insight from quantitative trade theory: that market access, derived from a structural gravity model, serves as a sufficient statistic for the equilibrium price index and thus productivity or welfare in each location. While this approach is elegant and tractable, it inherits several weaknesses.

In "Market Access in Global and Regional Trade" (2005), Mayer and Zignago underline the theoretical limitations of market access measures derived from trade flows, arguing that market access can be highly collinear with other geographic and institutional variables. , Indeed, market access is an aggregate spatial index that may conflate multiple channels (e.g., labor mobility, firm relocation, technology spillovers), and may not isolate the causal effect of railroads from other co-evolving forces such as urbanization, land policy, or institutional development. Thus, their critique suggests that Donaldson's and Hornbeck's empirical estimates may conflate multiple channels and obscure other important mechanisms, questioning the empirical sufficiency of market access as a metric for productivity or welfare.

B) *Static design and lack of dynamic adjustment*

The paper estimates a static treatment effect of railroad-induced changes in market access on land values using cross-sectional data. However, in reality, land prices may reflect expectations of future rents, not just current ones. If agents expect that railroads will spur longer-term industrialization, migration, or urban growth, this could inflate land values beyond the contemporaneous productivity gains. Indeed, land markets are forward-looking, and land prices may incorporate expectations of future growth, which could be driven by non-transport factors like industrialization, education, or political changes. Jedwab and Moradi (2016) show in Ghana that railroads had persistent effects due to agglomeration externalities and local public good provision, pointing to dynamics missing from Donaldson and Hornbeck (2016).

C) *Historical transportation routes are not always optimal*

On the contrary to what is implied in the paper, real economies may not use the lowest-cost routes due to frictions or political economy. In "Persistence and Path Dependence in the Spatial Economy" (2020), Allen and Donaldson develop a dynamic spatial model to examine how historical shocks can have persistent effects on the spatial distribution of economic activity. They emphasize that the placement of infrastructure is often influenced by historical contingencies and political factors, leading to path-dependent outcomes that may not align with the most efficient configurations. This challenges the assumption that trade flows naturally follow minimum-cost paths, and potentially disconnect modelled trade flow from actual economic behavior. As a result, if modeled trade routes overstate the efficiency of the historical network, then the estimated gains in land value or productivity from railroad access may be biased (the same goes for counterfactuals). Also note that the reliance on “iceberg” trade cost might obscure fixed handling costs, scale effects, and terrain irregularities captured by real freight costs.

D) Land value as a proxy for welfare and no explicit land use model

While agricultural land prices are a clever proxy to capture (agricultural) productivity gains under general equilibrium, this choice has limits. First, the assumption that land values internalize all welfare changes is debated. As Fajgelbaum and Schaal (2020) points out, welfare impacts differ across agents, and measuring only capitalized land values omits potential redistributional effects or sectoral transitions (e.g., from agriculture to manufacturing). Indeed, trade infrastructure also affects inequality, which challenges use of land value as a stand-in for broader economic welfare and critiques the neglect of distributional channels in Donaldson and Hornbeck (2016) analysis.

Moreover, urban economics models typically emphasize multiple land uses (residential, commercial, public), which the paper abstracts away from. The rural context may justify this, but it limits the generality of conclusions regarding spatial equilibrium. Thus, Donaldson and Hornbeck do not model land use behavior explicitly. Their framework assumes land values capture all spatial economic activity, but does not distinguish between residential, industrial, or mixed-use land, nor does it accommodate urban expansion dynamics. Finally, by omitting features such as commuting or agglomeration externalities in its model, the paper may bias estimates in regions transitioning toward urbanization.

Part II: Proposed extensions to address some limitations

A) Combine market access estimates with a structural multi-sector spatial general equilibrium model

Market access may aggregate effects from multiple spatial mechanisms (trade frictions, labor mobility, institutional variation) and thus fail to isolate the causal impact of infrastructure improvements. We suggest combining market access estimates with a structural multi-sector spatial general equilibrium model (as in Caliendo, Dvorkin, and Parro, 2019) to disentangle the mechanisms by which infrastructure affects economic outcomes.

First, we would need to construct a model in which trade, migration, and sectoral reallocation respond jointly to infrastructure shocks. Then, the model should be calibrated using county-level data on land values, population, wages, and sectoral output. Finally, we could use the model to simulate counterfactuals that separate pure gains from improved goods-market access, labor market adjustments, endogenous firm location decisions, and policy or institutional complements.

This approach directly addresses the concern that market access conflates multiple forces. It allows one to compute the share of land value changes attributable to trade cost reductions versus other mechanisms such as labor inflow or sectoral specialization.

B) Develop a dynamic spatial equilibrium model of land and labor markets

The paper's model fails to account for expectations, anticipation, and the longer-run dynamics of reallocation or agglomeration triggered by the railroad shock. That is why we propose the Develop a dynamic spatial equilibrium model of land and labor markets that captures both forward-looking behavior and temporal adjustment.

To implement it, we would need to embed dynamic forward-looking agents (e.g., landowners, firms, workers) in a spatial model where investment and migration respond to expected future market access. Then, using digitized historical data over multiple decades (e.g., 1850–1910), we could estimate a dynamic event-study of railroad exposure on land values, population, and sectoral transformation. This would allow to introduce anticipation effects by exploiting timing differences in railroad construction across counties.

This extension allows for an explicit comparison between short-run capitalization of expected rents and long-run realized productivity gains. It also enables the study of persistence, lag, and convergence dynamics, addressing the key limitation that land values may reflect future—not current—economic fundamentals.

C) Instrument route placement using historical and political determinants

The assumption that trade flows followed lowest-cost routes neglects political economy and frictions in infrastructure. This concern could be addressed by instrumenting route placement using historical and political determinants, then assess the divergence between optimal and actual routes.

For example, one could use 9th-century military maps, land survey plans, and congressional records to identify political and strategic factors (e.g., federal land grants, lobbying intensity) that influenced routing. Then, one could compare a frictionless optimal network" (based terrain and cost data) to the historical network, and estimate the economic loss from deviation between optimal and actual placement using spatial equilibrium simulations.

This design would allow to identify inefficiencies in infrastructure allocation and provides a basis for computing the welfare cost of political distortions in historical infrastructure investment and trade routes.

D) Augment the model with a land use equilibrium structure

Land value only reflects part of the welfare effects of infrastructure, and the framework lacks a theory of land use allocation (residential, agricultural, industrial). To address this issue, we propose to augment the model with a land use equilibrium structure (following the Alonso-Muth-Mills urban framework) to separate the impacts on land types and agents.

To implement this design, we would need to use census and tax data to distinguish between land ownership, land use (e.g., cropland vs. residential), and land tenure (owners vs. renters). Then, we could model households and firms as optimizing agents choosing land and location jointly based on wages, rents, and amenities, in order to estimate how railroad access changed land use composition and the distribution of welfare across agent types.

This approach recovers more nuanced measures of spatial welfare, identifies winners and losers, and distinguishes between gains to capital owners (land) and gains to workers (through wages or amenities), addressing the concern that land values are a narrow welfare proxy.

<u>Part III: Additional extensions and Variants</u>

A) Railroads and the Urban Fringe—Land Rents, Competition, and City Expansion

The expansion of the railroad network increased access to urban markets for distant rural producers, intensifying competition for farmers located near cities. This eroded the agricultural land rent advantage at the urban fringe, potentially reducing agricultural land rent or encouraging conversion of farmland to urban uses. Simultaneously, improved transport access made commuting and logistics easier, allowing cities to expand outward and shift the location of the urban fringe.

In this extension, we wish to test two hypotheses. First, agricultural land values at the urban fringe grew more slowly (or declined) relative to rural counties further away, due to increased market competition enabled by railroads. Urban expansion (e.g., population growth, land conversion to residential/commercial use) occurred disproportionately in fringe counties with improved rail access, consistent with a bid-rent driven urban boundary shift and lower farmers' rent.

Our conceptual framework builds on the monocentric model, adding the effect of increased competition in agriculture on farmers' land rent. Thus, land prices decline with distance from the city center, and when transport costs fall (as with rail expansion), the urban boundary expands and land at the fringe becomes more valuable for urban use, less so for agriculture. At the same time, the fall in good transport costs cause agricultural land near cities to face more competition from distant farm, reducing its profitability. This leads to two opposing forces on fringe land: a decline in agricultural land rent and an increase in land value as urban uses expand outward.

To implement this design, we would use Donaldson and Hornbeck (2016) GIS railroad network in 1870 and 1890. In addition, we would resort to digitized county-level data on agricultural land values, population and housing, from the US Censuses of Agriculture and Population (Haines, 2005). Finally, we would need data on land use (e.g. urban, cultivated, vacant), that could be available from tax rolls or Sanborn maps (for the urban fringe).

Then, we would define "urban fringe counties" as those within 10 miles of major cities, determined using a population threshold (e.g., cities >25,000 inhabitants). Each county would be attributed a type based on concentric distance bands, from urban-core to urban-fringe to rural.

We adapt the main specification to our design:

$$\Delta Y_o = \beta_1(\Delta MA_{ot} * Fringe_o) + \beta_2(\Delta MA_{ot} * Rural_o) + \gamma X_o' + \delta_{st} + \epsilon_{ot}$$

Where Y_o is our outcomes, that is: land value, share of cultivated land, population density, shift in labor force from farming to other occupations. ΔMA_{ot} represents the change in market access from 1870 to 1890, $Fringe_o/Rural_o$ indicate the location type, and X_o' is a vector of county-specific controls for initial land use, soil quality, existing trade routes proximity (e.g. canal, waterway), and economic development. Finally, δ_{st} corresponds to a state-year fixed-effect.

This extension would contribute to the literature in three ways. First, it would test classic bid-rent predictions from urban economics under historical infrastructure shocks; shows how urban expansion interacts with rural land values and agriculture. Then it would bridge the rural-focused analysis from Donaldson and Hornbeck (2016) with urban transition, offering a richer picture of how infrastructure shaped both agricultural decline and urban growth. Finally, it offers insights on how infrastructure affects land use transitions, which is critical for modern debates in development economics.

B) Railroads and French Economic Growth: a "Market Access" Approach

We want to test whether the economic impact of railway expansion in 19th-century France mirrors the effects estimated by Donaldson and Hornbeck (2016) in the U.S., particularly the capitalization of market access improvements into agricultural land values. Thus, our research question is: Does improved market access due to France's 19th-century railroad expansion increase agricultural land values, consistent with structural trade theory predictions?

France experienced a major wave of railway construction from 1840 to 1870, similarly transformative to the U.S. case. However, unlike the US, France had denser pre-existing transport infrastructures (roads, canals, rivers), smaller spatial scale and fewer (or no) "frontier" regions, fixed cadastral system for land tenure, strong state intervention, less internal migration and higher population density. By testing the same framework in France evaluates whether market access effects generalize across geographies with different frictions, settlement patterns, and state roles in infrastructure.

Our conceptual framework would be based on the same theoretical as Donaldson and Hornbeck (2016). We would mobilize data from several historical sources. First, we would need to digitize historical railway maps of France between 1840 and 1870, or rely on geocode data of all French railway stations in 1852 and 1870 from Chambru, Henry, and Marx (2024). For agricultural land value and use, we could use data from the Enquêtes Agricoles of 1852 and 1866-70 from the Statistique de la France. Population data are available in the Cassini database at the municipality level (censuses). Finally, we could gather data on topographic and geographic controls, such as terrain ruggedness or soil quality (from GAEZ database), as well as canal and road network overlays.

Following the same logic as Donaldson and Hornbeck (2016), we would compute minimum-cost freight distances between each pair of administrative units, and then assign costs to different transport modes to constrict municipalities or cantons market access. We would then compare market access in 1850 (early years) to 1870 (post expansion). The reason we do not focus on 1840 as start date is the lack of consistent data on agriculture. Our empirical specification would then be similar to the original paper:

$$Y_o = \beta lnMA_{ot} + \delta_o + \delta_{st} + f(x_o, y_o)\delta_t + \epsilon_{ot}$$

The only difference is that we test Y_o to be land value, share of agricultural land, or population density. Note we could also use 1842 planned rail lines (loi de 1842) as an instrument for realized network in 1870. This plan laid out a theoretical grid before private firms modified it, could serve as a quasi-exogenous variation.

This variant would test whether Donaldson and Hornbeck (2016) results are robust to institutional, geographic, and demographic variation. Then, it would offer insight into France's centrally planned rail system, compared to U.S. private networks. Finally, this would help Deepens our understanding of how market integration affects land markets and regional development under different path dependencies.

References:

Allen, Treb, National Bureau of Economic Research., and Dave Donaldson. *Persistence and Path Dependence in the Spatial Economy*. Cambridge, Mass: National Bureau of Economic Research, 2020.

Bairoch, Paul. *European trade policy, 1815-1914*. In Mathias, P. and Pollard, S., editors, Economic History of Europe, vol. 7. Cambridge University Press, Cambridge, 1989.

Caliendo, Lorenzo, Maximiliano Dvorkin, and Fernando Parro. "TRADE AND LABOR MARKET DYNAMICS: GENERAL EQUILIBRIUM ANALYSIS OF THE CHINA TRADE SHOCK." Econometrica 87, no. 3 (2019): 741–835. doi:10.3982/ECTA13758.

Chambru, Cédric, Emeric Henry, and Benjamin Marx. "The Dynamic Consequences of State Building: Evidence from the French Revolution." The American Economic Review 114, no. 11 (2024): 3578–3622. doi:10.1257/aer.20220110.

David, Paul A., ''Transport Innovation and Economic Growth: Professor Fogel on and off the Rails,'' Economic History Review, 22 (1969), 506–524.

Donaldson, Dave, and Richard Hornbeck. "RAILROADS AND AMERICAN ECONOMIC GROWTH: A 'MARKET ACCESS' APPROACH." The Quarterly Journal of Economics 131, no. 2 (2016): 799–858. doi:10.1093/qje/qjw002.

Eaton, Jonathan, and Samuel Kortum. "Technology, Geography, and Trade." Econometrica 70, no. 5 (2002): 1741–79. doi:10.1111/1468-0262.00352.

Fajgelbaum, Pablo D, and Edouard Schaal. "OPTIMAL TRANSPORT NETWORKS IN SPATIAL EQUILIBRIUM." Econometrica 88, no. 4 (2020): 1411–52. doi:10.3982/ECTA15213.

Fogel, Robert William. Railroads and American Economic Growth : Essays in Econometric History. Baltimore: Johns Hopkins Press, 1964.

Fujita, Masahisa, Paul R Krugman, and Anthony J Venables. The Spatial Economy : Cities, Regions, and International Trade. Cambridge (Mass.) London: MIT press, 1999.

Holmes, Thomas J., and James A. Schmitz, ''Competition at Work: Railroads vs.Monopoly in the U.S. Shipping Industry,'' Federal Reserve Bank of Minneapolis Quarterly Review, 25 (2001), 3–29.

Jedwab, Remi, and Alexander Moradi. "THE PERMANENT EFFECTS OF TRANSPORTATION REVOLUTIONS IN POOR COUNTRIES: EVIDENCE FROM AFRICA." The Review of Economics and Statistics 98, no. 2 (2016): 268–84. doi:10.1162/rest_a_00540.

Krugman, Paul. "Increasing returns and economic geography". Journal of Political Economy, 99(3):484–499, 1991.

Lebergott, Stanley, ''United States Transportation Advance and Externalities,'' Journal of Economic History, 26 (1966), 437–461.

Zignago, Soledad, and Thierry Mayer. Market Access in Global and Regional Trade. HAL CCSD, 2005.

Picard, Pierre M, and Dao-Zhi Zeng. "Agricultural Sector and Industrial Agglomeration." Journal of Development Economics 77, no. 1 (2005): 75–106. doi:10.1016/j.jdeveco.2004.03.002.

Puga, Diego. "The Rise and Fall of Regional Inequalities." European Economic Review 43, no. 2 (1999): 303–34. doi:10.1016/S0014-2921(98)00061-0.

Redding, Stephen, and Anthony J Venables. "Economic Geography and International Inequality." Journal of International Economics 62, no. 1 (2004): 53–82. doi:10.1016/j.jinteco.2003.07.001.