Seoul
Railroads and Commerce

URBAN AND REAL ESTATE ECONOMICS Final report

Hyukwoo Nam & Wooyong Park

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연세대학교
YONSEI UNIVERSITY

Article Recap.

Key Issues in the Railroad Underground allocation in South Korea: Questioning the Benefits

철도 지하화?… 막대한 사업비 걸림돌, 임기 내 착공도 어렵다

더불어민주당 이재명 후보와 국민의힘 윤석열 후보 등 여야 대선 후보들은 최근 수도권 교통 인프라 개선을 약속하면서 한목소리로 경인선과 경부선, 경원선 철도 가운데 현재 지상(地上) 구간들을 지하화하겠다는 구상을 밝혔다. 이에 따라 누가 대통령에 당선되든 철도 지하화 사업이 추진될 가능성이 높다.

하지만 야심 찬 대선 후보들의 선언과 달리 철도 지하화는 막대한 사업비와 상당한 기간이 필 업이다 보니 실제 착수하더라도 난관이 한둘이 아니다. 이미 두 대선 후보가 추산한

Enormous estimated project costs

-> Government estimates the total project cost at approximately 50 trillion KRW*
-> If project lacks profitability, possibility of it being overturned

Issue supported by both the current president and opposition candidates

-> Attracting national attention as a significant project
-> Both sides lack concrete plans for funding

Scope of project : Seoul Area

-> Planned for upper ground railroads across the Seoul-Metropolitan area

* 'Guideline for Railroad Embedment(철도 지하화 통합개발 가이드라인)' by the Ministry of LIT, May 7th 2024

Article Recap.

Key Controversies of This Project

Gov's Stand

1. Sufficient funding: The 14 trillion KRW project can be largely funded by **selling the newly available land**, covering 12 trillion KRW. The remaining 2 trillion KRW can be split between the government and local authorities. Rising real estate prices will also alleviate the financial burden.

2. Creating new spaces: Converting former railway areas into parks and recreational zones for regional development, while addressing housing issues with new apartments and increasing green spaces.

3. Traffic solutions: For example, the Gasan Digital Complex area suffers from severe traffic congestion due to the limited overpass connecting roads. The overpass design leads to traffic bottlenecks and accidents, worsened by nearby bus stops. Expanding roads hasn't solved the issue. Transforming the railway into a semi-underground or elevated structure could alleviate this congestion, improving traffic flow and connectivity.

Counterarguments to the Government's Stance

1. Insufficient funding: Selling the land from undergrounding won't cover the 14 trillion KRW cost. **Many sections have low development value due to poor accessibility or surrounding private properties.** High costs and complexity, especially in areas like Seoul Station to Noryangjin, make it impractical. Extensive funding needs could slow other rail projects, as seen with GTX

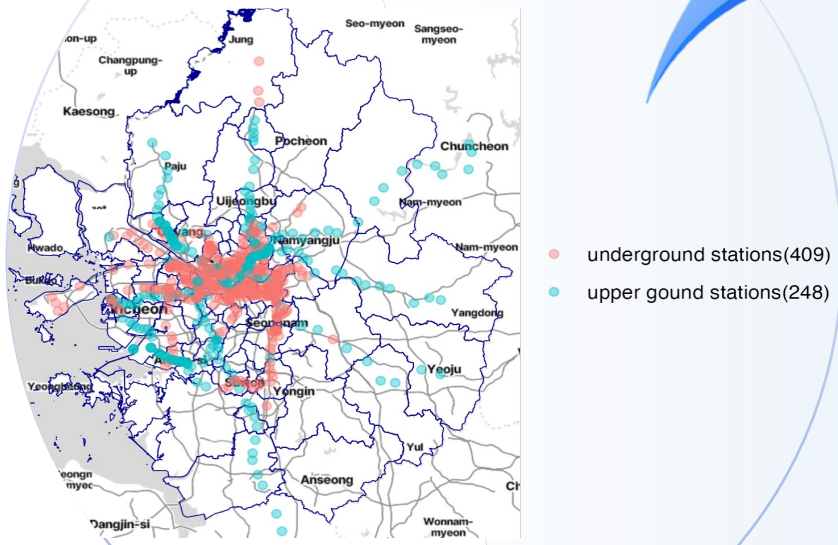
2. New spaces remain inefficient: Underground rail **conversion leaves narrow, linear plots (30-40m wide) unsuitable for development**. While parks benefit public welfare, this contrasts with claims of funding through land sales. These narrow plots often stay underutilized, highlighting their limited value.

3. Rail unavailability during construction: Prolonged construction will incur high costs and lack alternative transportation, leading to a severe traffic overload. This cannot be justified solely by a transportation improvement.

Distribution of Subway Stations in Seoul

Topics of Interest

- Why are the stations on-land at the first place?
- What are the **economic benefits of railroad embedment?**



Key findings

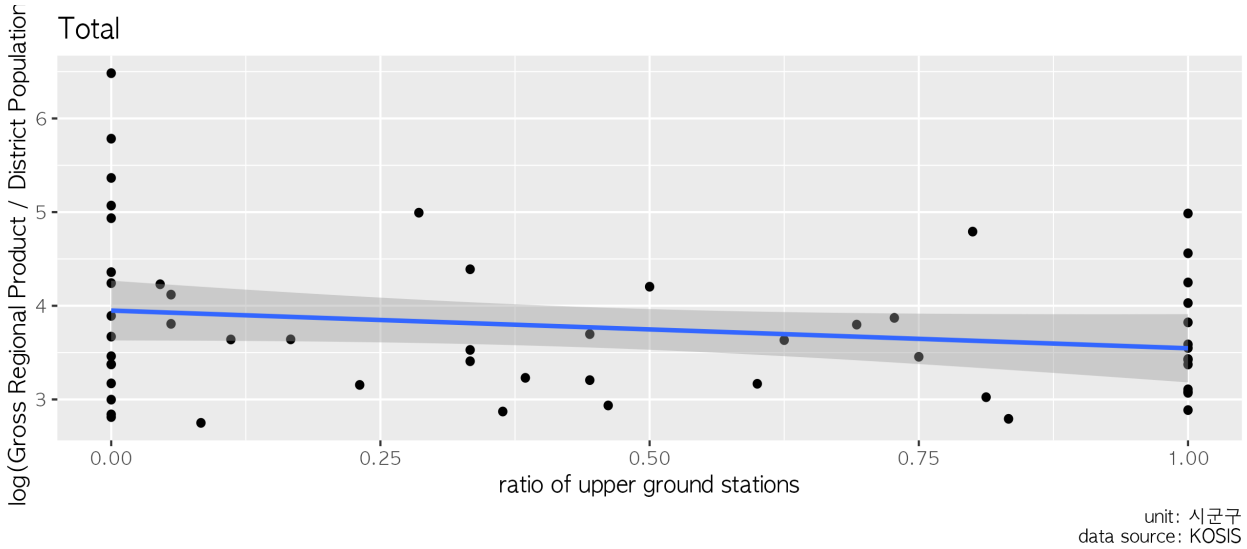
- Upper ground stations might have negative impact on local commerce.
- The disutility of having upper ground station is different among sectors.
- Upper ground stations allocate local businesses unevenly.

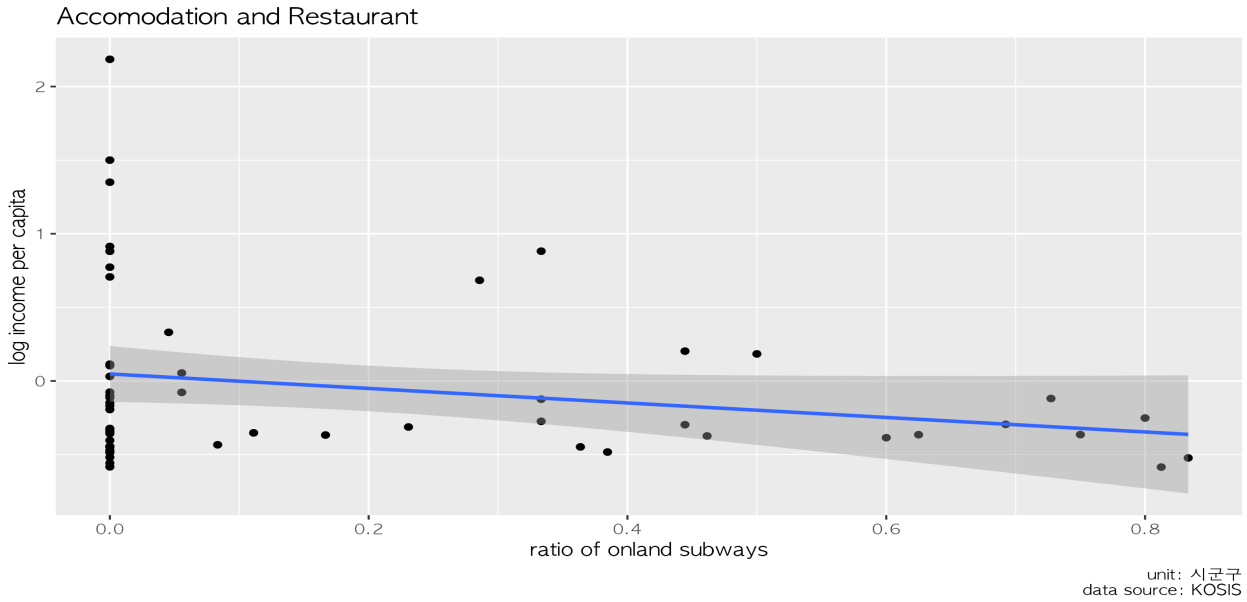
Why On-land?

- Historical
- Natural Constraints

"In the vicinity of rivers with weak ground, urban railroads sometimes come up from underground, pass through rivers and soft ground, and then go back to underground. However, **this trend was strong in urban railroads during the construction of the first Seoul subway system** (1970s and 1980s), and as construction technology advanced, they used technology to go deeper underground instead of going up to the ground to avoid soft ground. (GTX's great depth is an example.)" – Expert Interview

Upper Ground Stations and Regional Economy





Data shows that

- Ratio of upper grounds subway stations are negatively correlated with regional economy.
- These correlations are different among sectors, especially strong in commercials: restaurants, culture, and accommodation.

	Model 1
(Intercept)	−0.21
	(0.12)
ratio	−0.50*
	(0.24)
seoul	0.62***
	(0.13)
Num. obs.	80
R^2 (full model)	0.26
R^2 (proj model)	
Adj. R^2 (full model)	0.24
Adj. R^2 (proj model)	

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

Can we conclude that upper ground subway stations deter regional growth?

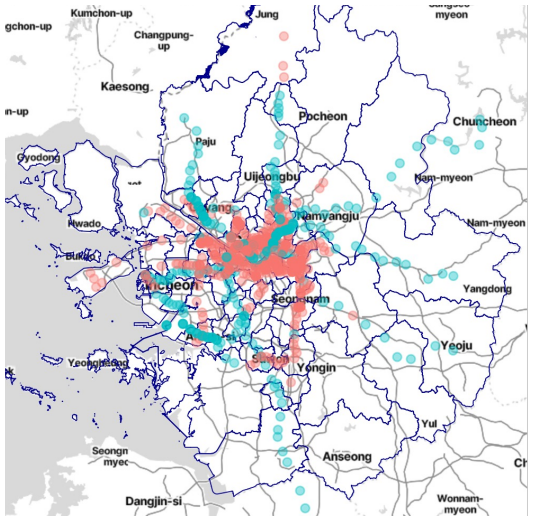
Upper Ground Stations and Regional Economy

Two Concerns

1. Sample size is too small. → Firm Level Employment Data(전국사업체조사)
2. Reverse Causality

On land Stations ⇄ Economy

Districts with low level of economic activity has more vacant lands.

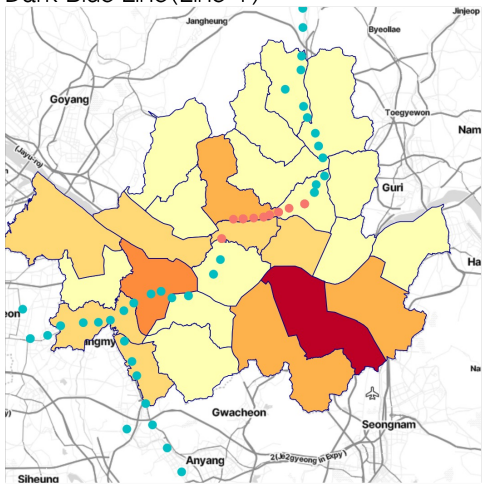


Identification Strategy(Fixed Effects on 시군구)

One can easily suspect the existence of reverse causality even in the case of the Dark Blue Line. Although the construction was made early and was more affected by exogenous constraints, central Seoul is covered with under ground stations(station Sicheong(시청) to Jongmyoap(종묘앞)).

Therefore, we tried to control economic differences across 시군구 with 시군구 level fixed effects, and compare the effects of upper ground stations in the dong level within the same 시군구.

Dark Blue Line(Line 1)



Filled color represents the regional GDP of each district.

Upper Ground Stations and Regional Economy

Model Specification

$$Y_{d,s,j} = \beta_1 onland\_major_d + \beta_2 n\_total_d + \tau_s + \theta_j + +\epsilon_{d,s,j}$$

- $Y_{d,s,j}$: The average employment of industry s in dong d (logged)
- $onland\_major_d$: Dummy indicating whether the dong has more upper ground stations or not
- n_total_d: total number of stations in that dong
- θ_j: 시군구 fixed effects
- τ_s: industry fixed effect

Regression Results

	All Sectors		Restaurants and Accomodation	
	Model 1	Model 2	Model 3	Model 4
onland_major	0.03	0.03	−0.07	−0.07
	(0.08)	(0.08)	(0.07)	(0.07)
n_stations		0.00		−0.00
		(0.02)		(0.01)
Num. obs.	1850	1850	124	124
Num. groups: sgg	25	25	25	25
Num. groups: sector	17	17		
R^2 (full model)	0.66	0.66	0.41	0.41
R^2 (proj model)	0.00	0.00	0.01	0.01

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

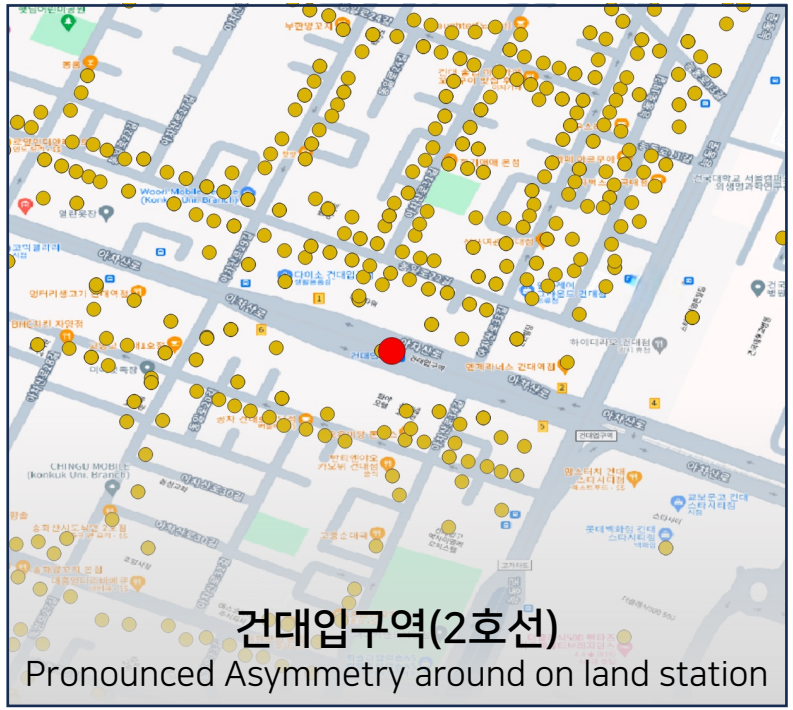
Table 3: Baseline Model

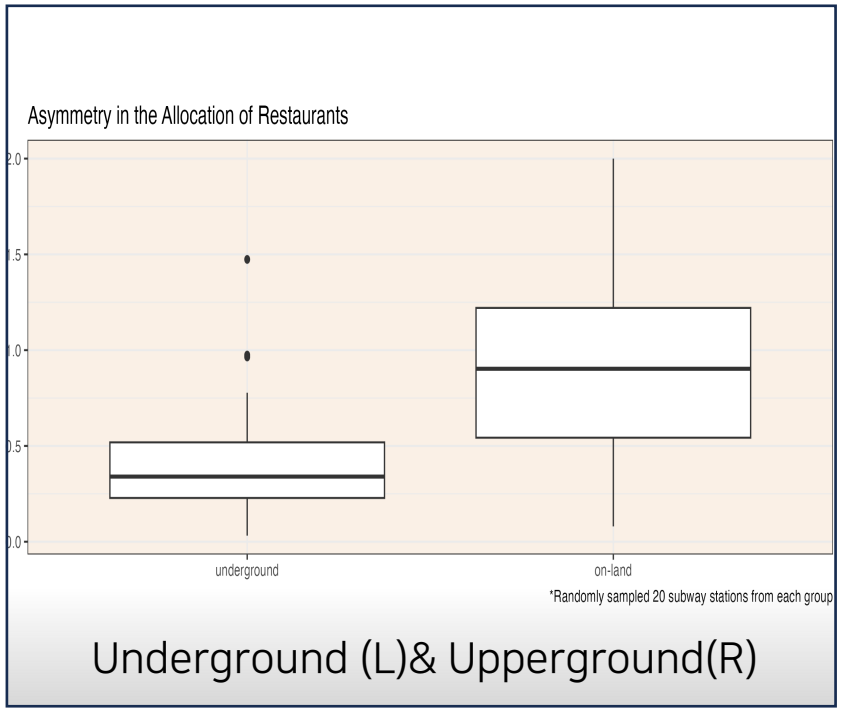
Although we couldn't obtain statistically significant level of coefficient, similar pattern of restaurants being more negatively affected by upper ground stations appeared also within the same district(시군구).

Also, when we regressed each firm's employment level on the ratio of upper ground station in the same 시군구, it showed similar patterns with statistically significant values.

Though we need a more rigorous analysis, this regression does suggest the possibility of upper ground stations having different level of impact among sectors.

Spatial Distribution of Restaurants around Station





Statistically significant asymmetric local development in the vicinity of upper ground stations

(Two sample T-test: t-value = -3.46, p-value < 0.001*)

*Red points indicate the station, and yellow points indicate restaurant businesses.(QGIS Location Image)
*Data Source: 공공데이터포털 “소상공인시장진흥공단_상가(상권)정보”

Model Explanation for the Imbalanced Distribution

Key Results

- Consumers' preference for consumption variety and the presence of moving cost(in the presence of upper ground stations) can cause imbalanced market size.
- Price levels might be different between each zone.

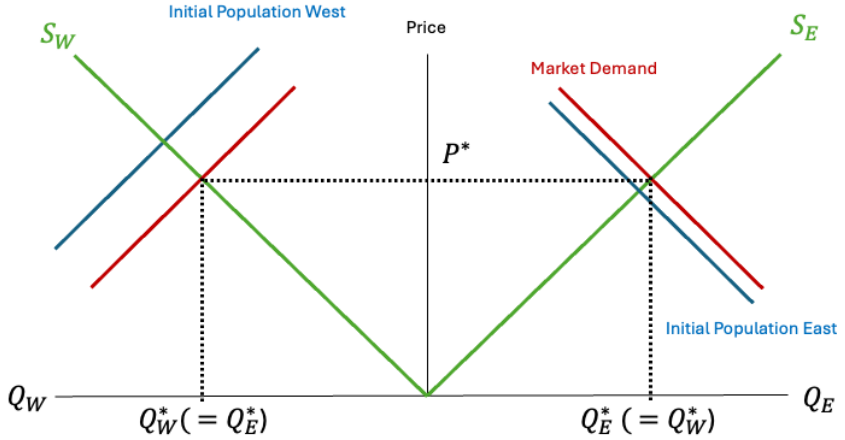
Assumptions

- There are two zones: W(est), E(ast)
- Firms' marginal cost in each zone is symmetric.
- Each firm sells heterogeneous products, but they are near-perfect substitutes to each other.
  → They compete in the same market and face the same market demand.
- Initially, one zone has slightly larger dwelling population than the other.
- Upper ground station causes the moving cost c for each consumer.
- Consumer's benefit from moving is i.i.d., conditional to the other zone's market size and price level, denoted by B_i.

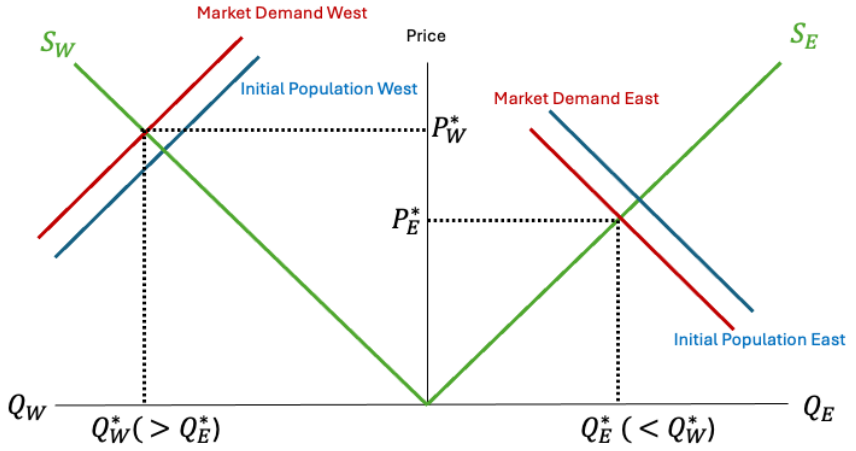
$$B_i \sim F(B; Q_{-i}, P_{-i}) \text{ for } i \in \{W, E\} \quad \text{where} \quad {}^{\partial F}/_{\partial Q_{-i}} < 0, \; {}^{\partial F}/_{\partial P_{-i}} > 0$$

- Consumer in zone i moves to the other zone if and only if $B_i \geq c$.

Without Upper Ground Railroads



With Upper Ground Railroads(Case 1: Elastic Supply)



Conclusion

Conclusion

- Although the government puts emphasis on the benefit from increasing public zones and alleviating traffic congestions, **economic benefit from the change in employment and production must also be accounted** for a better cost-benefit analysis.
- Upper ground stations *might* have negatively impacted the local economy compared to the under-ground counterparts, and this effect varies between different sectors.
- There is a significant imbalance between upper ground and under-ground stations in the **asymmetry of commercial distribution.**

Caveats and Suggestions

- A more rigorous analysis and fine data is required to identify the causal impact of these stations and railroads.
- Results on commercial asymmetry requires a larger data to robustly be confirmed.
- By estimating the monetary value of the increase in employment size and other economic changes that the embedment might bring, we can have a clearer cost-benefit analysis to determine whether the embedment is profitable or not.