

# Railway Expansions and Human Capital Growth: A 20-Year Causal Analysis in Tokyo

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## 1. Introduction

We explore whether public transportation can promote human capital growth, which includes the knowledge and skills that individuals possess. Human capital is essential for driving economic growth, spurring innovation, and enhancing social equity (Angrist et al., 2021). Its significant role in economic development has been thoroughly studied, highlighting the need to cultivate this vital resource (Hall and Jones, 1999; Hanushek and Woessmann, 2022). Moreover, theoretical models suggest that travel options which are affordable and efficient, thereby facilitating greater interaction among people, can boost human capital (Rauch, 1993). Despite this, direct empirical evidence on the subject is scarce.

Our study delves into the impact of transportation infrastructure on human capital in Tokyo over the past two decades, utilizing detailed data on educational attainment, occupational structures, and railway network expansion to probe causal relationships. We address two pivotal research questions: (1) Does railway expansion enhance human capital? and (2) Does it distribute human capital uniformly or concentrate it around already developed areas? By leveraging extensive historical data, we evaluate the long-term socio-economic effects of transportation improvements on human capital. We employ indicators such as the percentage of university graduates and the proportion of high-skilled workers as proxies for human capital, recognizing their roles not only as fundamental components but also as predictors of potential income growth. Analyzing town-level data enables us to discern the causal links between public transportation developments and variations in human capital, incorporating variables like market access to fully capture the wide-ranging effects of transportation, both direct and indirect, including the influence of railway accessibility and density.

## 2. Methodology

The estimation equation is as follows:

$$\ln H_{ot} = \beta_1 \ln(\text{RailIndex}_{ot}) + \delta_{rt} + \varepsilon_{ot}.$$

In our model,  $H_{ot}$  represents the socioeconomic index for town  $o$  in year  $t$ . We use university graduate rates and high-skilled worker rates as the primary dependent variables to gauge the human capital of each town.  $\text{RailIndex}_{ot}$  comprises indices of railway accessibility, including the

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presence of a station within a 2km radius, MA, rail line density (expressed as km/km<sup>2</sup> within a 2km radius), and the number of rail lines available in town  $o$  in year  $t$ . To account for region-specific time trends in our dependent variables, we control for city-by-year fixed effects.

### 3. Results

As a result, railway expansion has been shown to significantly contribute to an increase in the number of university graduates and high-skilled workers, especially in towns with initially lower rates of university graduates. Table 1 provides detailed coefficient estimates, demonstrating the effect of a one-unit change in the explanatory variables on the percentage changes in university graduate rates and skilled worker rates. In Panel (A), it is shown that towns within a 2km radius of a station have university graduate rates and high-skilled worker rates that are 8.17% and 2.11% higher, respectively, compared to towns without a station. Panel (B) indicates that a 1% increase in MA corresponds to a 2.65% increase in university graduate rates and a 0.65% increase in high-skilled worker rates. Furthermore, Panels (C) and (D) reveal that both rail line density and the number of available rail lines have a positive impact on increasing the rates of university graduates and high-skilled workers.

Table 1. Estimated coefficients of full sample regression.

|         | Panel (A) Station |             | Panel (B) MA |             | Panel (C) Line density |             | Panel (D) Num. of lines |             |
|---------|-------------------|-------------|--------------|-------------|------------------------|-------------|-------------------------|-------------|
|         | ln(Graduate)      | ln(Skilled) | ln(Graduate) | ln(Skilled) | ln(Graduate)           | ln(Skilled) | ln(Graduate)            | ln(Skilled) |
| Station | 0.0817***         | 0.0211***   | 0.0265***    | 0.00650***  | 0.102***               | 0.0356***   | 0.0487***               | 0.0171***   |
| N       | 102905            | 105412      | 102905       | 105412      | 102903                 | 105412      | 102905                  | 105412      |
| R-sq    | 0.672             | 0.84        | 0.668        | 0.839       | 0.665                  | 0.839       | 0.663                   | 0.839       |

### 4. Conclusion

Our research supports the proposition that railway system expansion is a viable strategy for fostering human capital growth, as evidenced by an in-depth examination of Tokyo's railway expansion efforts. Additionally, our study provides essential insights for integrating railway expansion projects into a broader urban policy framework, offering valuable guidance for strategic urban development and planning.

### References

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