How Stockholm Builds Infrastructure Cheaply, and Why It's Becoming More Expensive

Transit Costs Project

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TCP: Introduction

The Transit Costs Project is an investigation into the comparative costs of metro construction around the world. These differ by more than an order of magnitude: in 2022 PPP dollars, the range for recent full subways is $100 million to $2 billion per km.

This includes the following program:

- Construction costs database
- Case studies: Boston, Istanbul, Italian cities, Stockholm, New York

This work is **related** to work in the literature (e.g. in Flyvbjerg) on cost overruns, but we study absolute costs and increases in costs from project to project, not costs relative to prior estimates.

TCP: Database

We have 900 items in our database covering 20,000 km, nearly all recently-built or under construction. A majority are in China, but more than 50 countries are represented.

The average is in PPP dollars around $200 million/km; in 2022 PPP dollars for purely underground lines, it's $300 million/km.

What causes these costs?

Costs and Institutions, Part 1

The biggest correlate of a metro line's cost per km is **what country it is in**—dummy binary variables for country have stronger correlation than even whether it's elevated or underground.

If a city has cost averages that differ from the national average, there is a reason.

- Example: Germany tends to build metro (not commuter rail) tunnels for about $350 million/km, but in Nuremberg it's somewhat cheaper—and Nuremberg also has different metro planning standards from the rest of Germany.
- Example: China tends to build metro tunnels for about $250 million/km, but in Shanghai it's much higher, which we've been told is due to the alluvial soil.

Costs and Institutions, Part 2

The observation about countries also applies to **macro regions**.

The Anglosphere (US, UK, Canada, Australia, New Zealand, Singapore, Hong Kong) shares very high construction costs.

Most of the Anglosphere also shares a similar cost history—the peripheral Anglosphere's costs were lower in the 1980s and 90s and exploded afterward.

The Nordic region has similar costs and history as well: very low costs until about 2010, followed by rapid rise.

This motivates studying Stockholm in detail: why was it so inexpensive to build? And why are its costs rising so fast?

Mid-20c Sweden

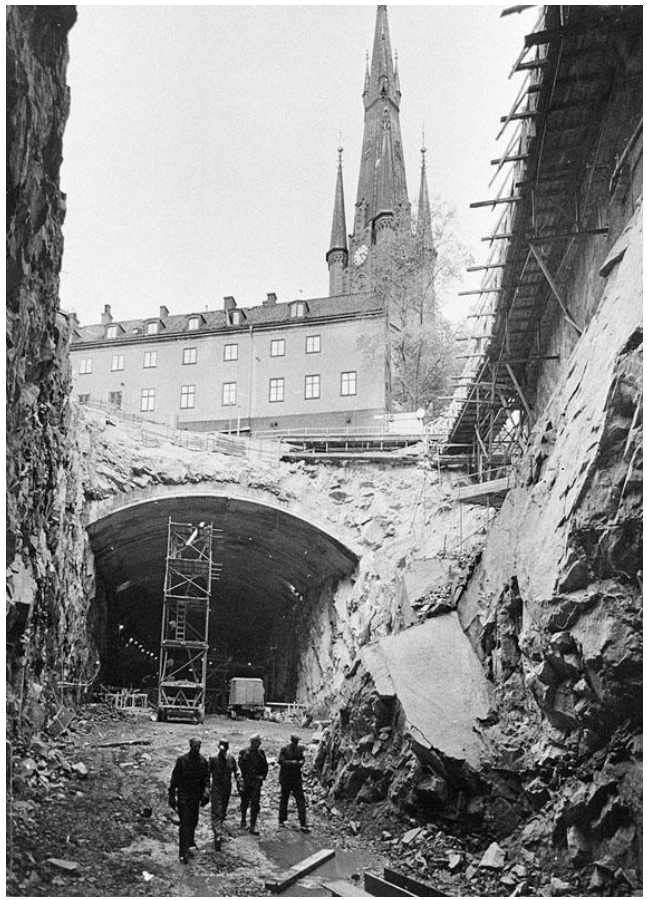
Sweden developed early on many institutional and social indicators, but it urbanized and industrialized late by US/UK standards.

Stockholm County had 1 million people in the 1940s, and the working class suffered from overcrowding and substandard housing. Traffic congestion had been a problem for a generation.

Development at the time tended to be state-led, and planning in the forerunner of Trafikverket was influenced by the American model of the Bureau of Public Roads, stressing apolitical, expert decisionmaking; in Sweden this would lead to a process driven by benefit-cost ratios.

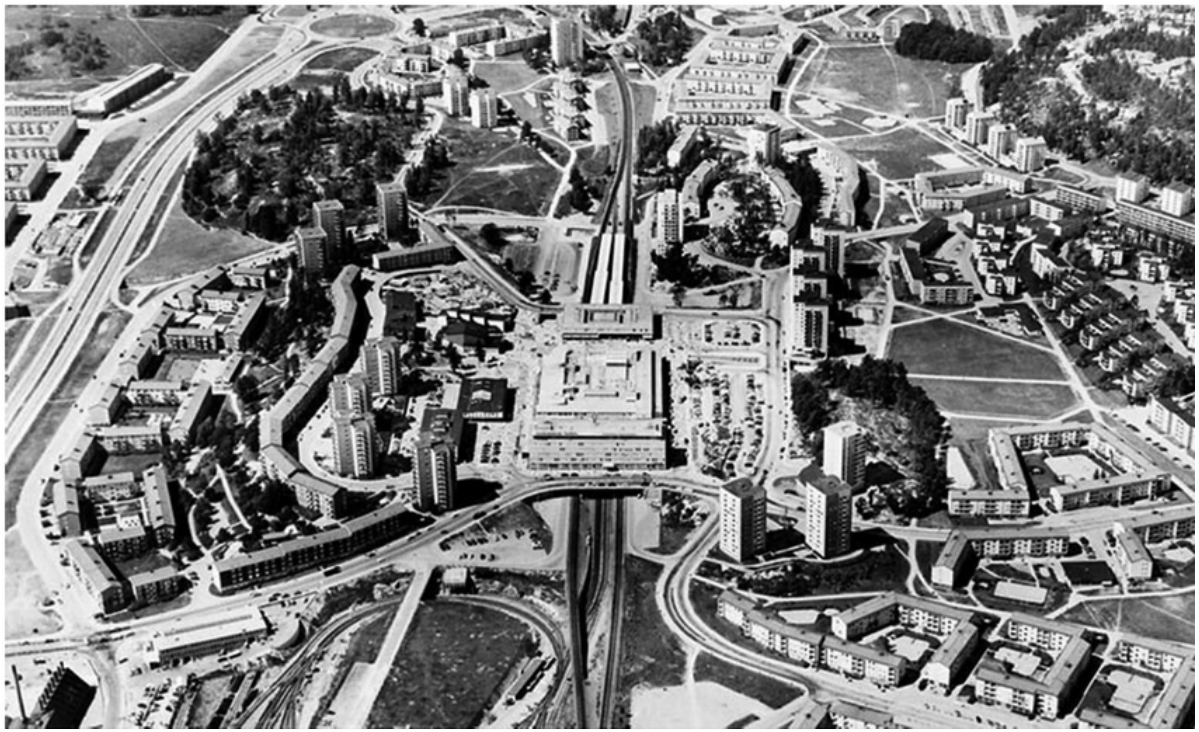
T-Bana Construction

The T-Bana was constructed as part of a coordinated multi-line plan, to the point that the Green and Red Lines meet in cross-platform interchanges.



TOD and the Million Program

The T-Bana was built simultaneously with master-planned new towns, starting with Vällingby (1954) and continuing with the Million Program (1965).



T-Bana Success

The three-line system cost, in 2022 PPP dollars, about $50 million per km (maybe $75 million for just the underground parts).

Ridership is high: 1,265,900 riders/weekday in 2019; 1,892,300 with all other rail in the area. The modal split is about 40%. TOD is extensive:

Expansion History

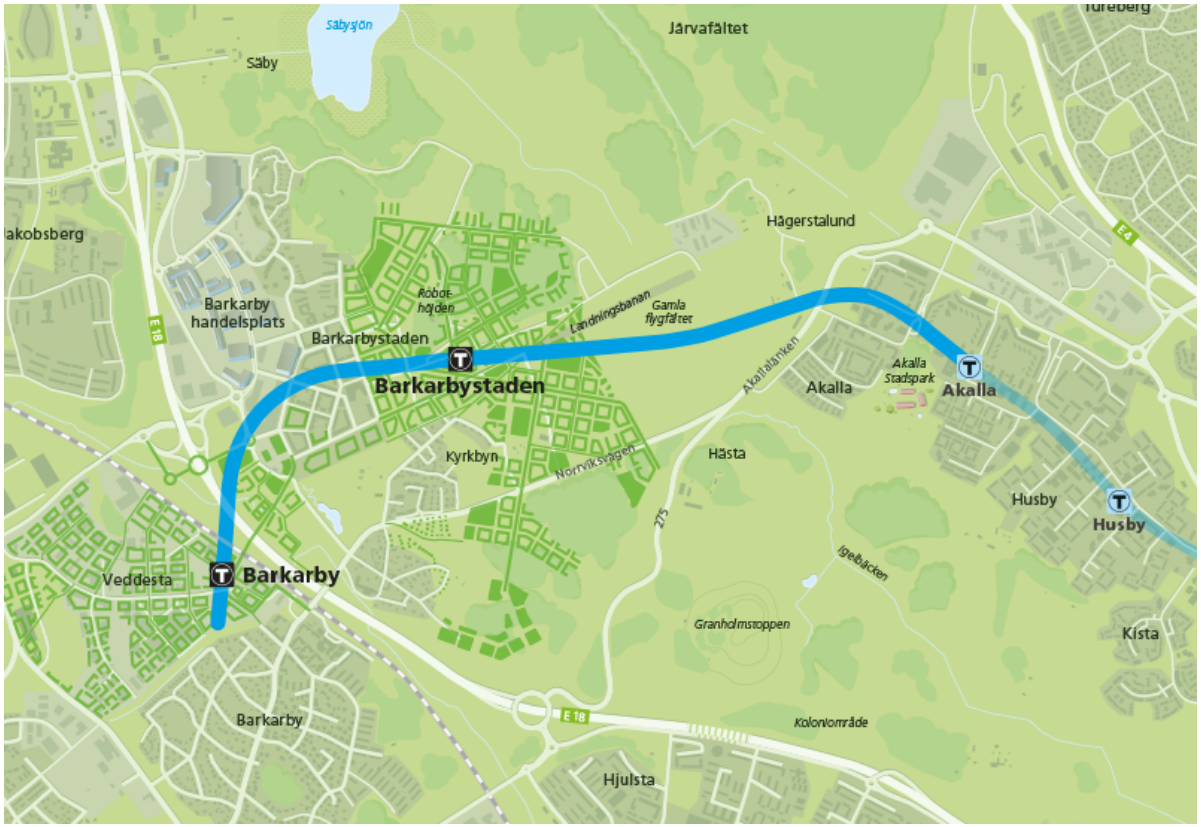
High Swedish economic growth recovering from the early-1990s crisis led to projections of the existing transport system reaching capacity.

This led to plans for rail expansion:

- Citybanan: a two-track 6 km commuter rail tunnel under Central Stockholm to relieve the two-track commuter rail bottleneck feeding Stockholm Central, built 2007-16 for around $360 million/km.
- Nya Tunnelbanan: a 19 km expansion of the T-bana in three directions, currently projected at 32 billion SEK in 2016 prices or $230 million/km in 2022 PPPs.

Expansion Planning

Plans for expansion involve a combintion of expert bureaucracy and long-term area growth plans. Much of the service area of Nya Tunnelbanan is slated for TOD—the shape rather than serve model.



Physical Construction

Exact comparisons with other projects are difficult. Stockholm uses **drill-and-blast** tunneling rather than the usual combination of tunnel-boring machines and cut-and-cover stations.

Stations are mined caverns, of about the same size needed for passenger circulation.

Access points are built into parks and other open land; emergency egress if needed uses the service tunnels (e.g. Sofia).

Labor

Contractors report that Swedish construction is designed around maximum labor efficiency.

The labor force is entirely domestic and foreign migrant workers: none of the miners building Nya Tunnelbanan is a native Stockholmer. The miners are paid about $90,000 a year plus temporary housing benefits, the other workers are paid less.

Procurement and Risk

Procurement is the **likely** long-term problem with construction costs. There is a move from a traditional state-led system to a contractor-led system that is viewed as more globalized:

- Contracts are traditionally itemized, but there is a transition to fixed price contracting.
- Bigger contracts are designed to improve global competition.
- Design-build is supposed to reduce conflict between design and construction teams.
- More of the risk is put on the private contractors.
- Trafikverket is moving to a pure client model.