Infrastructure Investment to Economic Growth in Ho Chi Minh City
(Stochastic Growth Model)

Ho Chi Minh is one of the biggest city and largest economy hub in Vietnam, contributing significantly to the country's economic growth, particularly GDP. According to Ho Chi Minh Times, in 2024, Ho Chi Minh reaches gross regional domestic product (GRDP) growth of 7.17%. Key sector contributions include industry and construction (6.89% increase), trade and services (7.7% increase), retail sales (10.7% increase) and travel services (55% increase) (*Ho Chi Minh City Forecasts Strong Economic Growth for 2024 - Ho Chi Minh Times*, 2024). Infrastructure is their top priority with projects like Thu Thiem – Long Thanh railway, Can Gio port, and Metro line 1. The city's exports increased 8.3% to US$46 billion, and imports increased 5.9% to US$58.6 billion (Gia Nghi, 2024). The figure 1 below shows an increasing trend of GDP index in Ho Chi Minh city from 2004 to 2018 indicating a steady economic growth from the past.

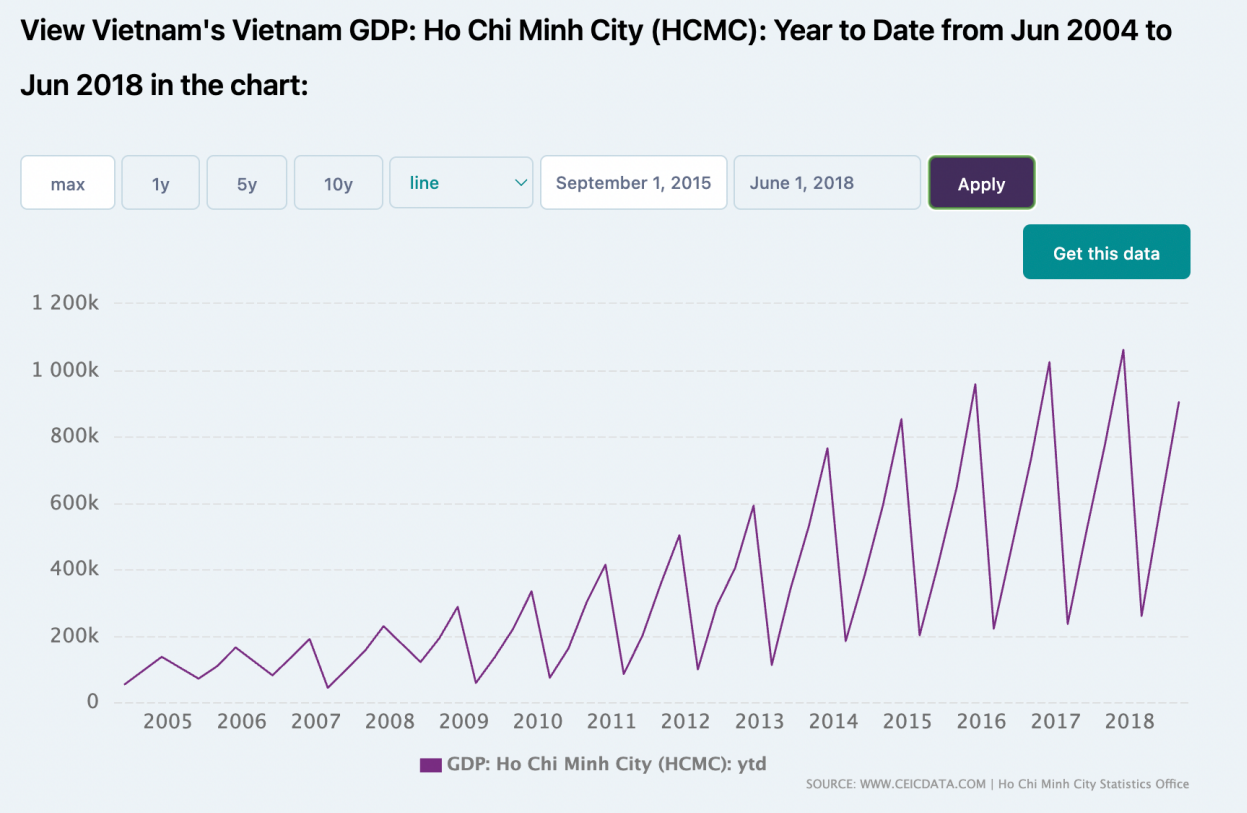


Figure 1: Ho Chi Minh's GDP from 2004 to 2018 (CEICdata.com, 2018)

There are multiple factors that affect Ho Chi Minh's economic growth. Some of them are due to investment and capital accumulation, great consumption and demand, external trade and global integration, tourism, and travel services. In this project, infrastructure

investment will be investigated since it was indicated as the city's priority in maintaining economic growth. Higher levels of investment in infrastructure contribute to long-term economic growth. Infrastructure projects like Metro system or ports reduce the travel time thus lower transportation costs resulting efficiency and competitiveness of exports in logistics and trade sector. Infrastructure projects also attract Foreign Direct Investment. Ho Chi Minh has attracted $1.54 billion in Foreign Direct Investment (FDI) in the first 6 months of 2024 (Huyền Vy, 2024). This investment creates many construction jobs and increases land and property values in surrounding areas, further stimulating the city's economic growth. Ho Chi Minh City has recently ramped up public investment in improving infrastructure, reducing delays in key projects, and enhancing public services. To reduce congestion, the city is expanding its metro system and implement intelligent traffic management systems to optimize flow and reduce travel times. The city also accelerates the completion of ring roads 3 and 4 and other delay projects by cutting 30% of administrative procedures. (Bich Ngoc, 2025).

To incorporate the effect of public investment and infrastructure development on economic growth, an extended stochastic growth model has been developed. The utility function with public infrastructure g_t effects is following:

For $\sigma \neq 1$

$$U(c_t, g_t) = \frac{\left(c_t {g_t}^{\theta}\right)^{1-\sigma}}{1-\sigma}$$

For $\sigma = 1$

$$U(c_t, g_t) = ln(c_t) + \theta ln(g_t)$$

Where,

c_t is consumption
g_t is public infrastructure
θ is the effect of public infrastructure on utility derived from consumption, higher θ greater benefits gained from public infrastructure (e.g., reduced congestion)
σ is risk aversion

Production function with public infrastructure g_t is the following:

$$y_t = A_t F(k_t, g_t) = A_t {k_t}^{\alpha} {g_t}^{1-\alpha}$$

Where,

A_t is stochastic productivity shock
k_t is capital
g_t is infrastructure investment by government

Capital accumulation:

$$k_{t+1} = (1 - \delta_k)k_t + i_t$$

Where,

δ_k is depreciation rate of capital
i_t is private investment

Infrastructure investment by government:

$$g_{t+1} = (1 - \delta_g)g_t + {i_t}^g$$

Where,

δ_g is depreciation rate of infrastructure
${i_t}^g$ is new infrastructure investment by government

Budget constraint:

Let's assume that public infrastructure investment is purely taken from tax revenue

$$c_t + k_{t+1} = (1 - \tau)y_t$$

$${i_t}^g = \tau y_t$$

$$c_t + k_{t+1} + {i_t}^g = (1 - \tau)y_t + \tau y_t = y_t$$

Where,

τ is tax rate

Recursive formulation (Bellman equation)

$$V_t(k_t, g_t, A_t) = \max_{c_t,\, k_{t+1},\, {i_t}^g} \{U(c_t, g_t) + \beta E_t V_{t+1}(k_{t+1}, g_{t+1}, A_{t+1})\}$$

$$= \max_{c_t,\, k_{t+1},\, {i_t}^g} \left\{ \frac{\left(c_t {g_t}^\theta\right)^{1-\sigma}}{1-\sigma} + \beta E_t V_{t+1}(k_{t+1}, g_{t+1}, A_{t+1}) \right\}$$

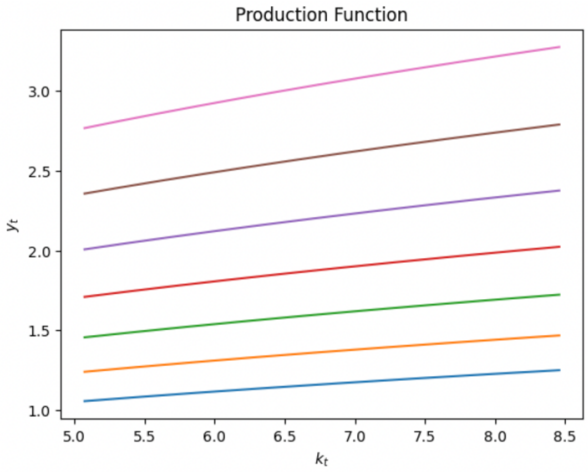
subject to

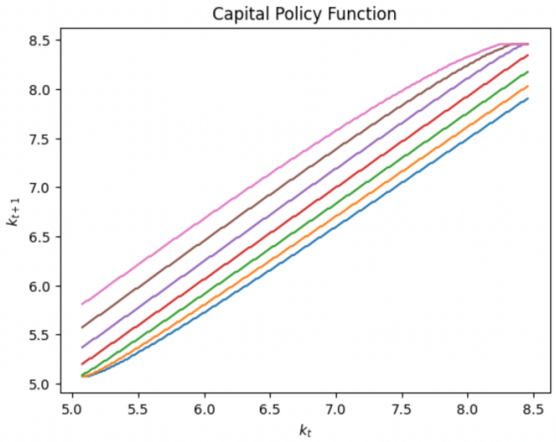
$$c_t + k_{t+1} - (1 - \delta_k)k_t + {i_t}^g = A_t {k_t}^\alpha {g_t}^{1-\alpha}$$
$$g_{t+1} = \left(1 - \delta_g\right)g_t + {i_t}^g$$

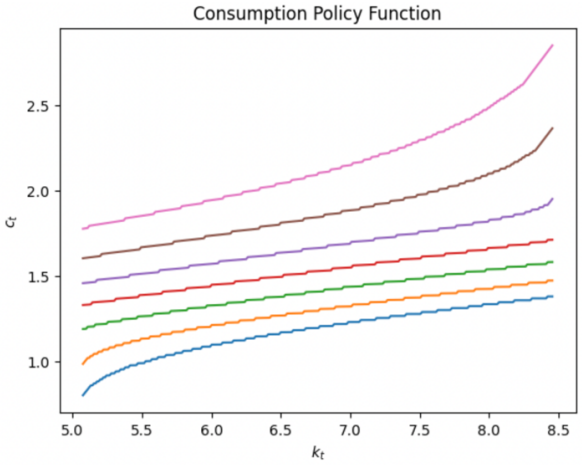
$$log(A_{t+1}) = \mu + \rho log(A_t) + \epsilon_{t+1}$$

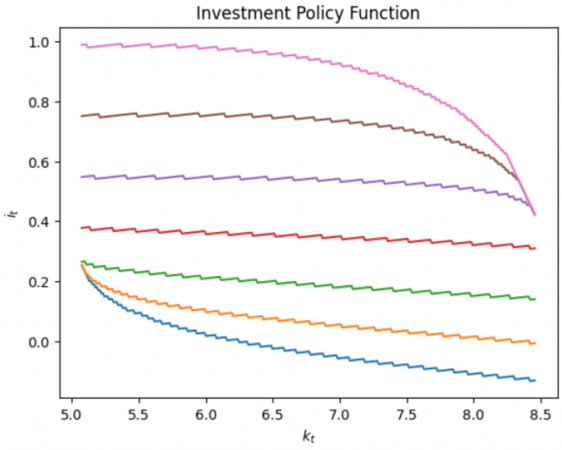
$$c_t > 0,\ k_t > 0$$

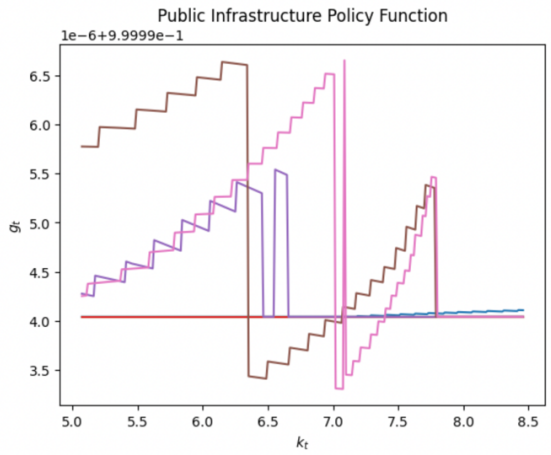
After running the new stochastic growth model using Python, we have the following results.

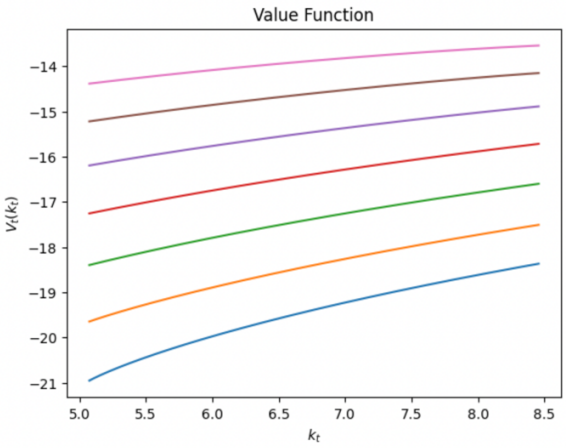


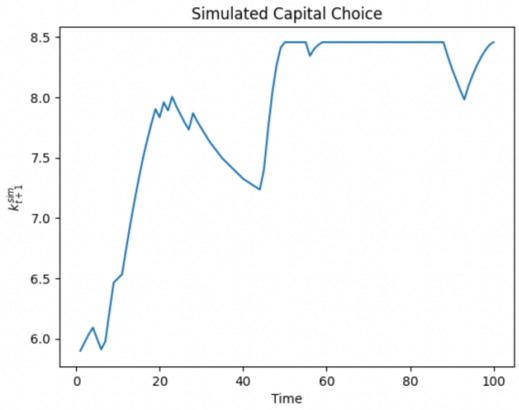


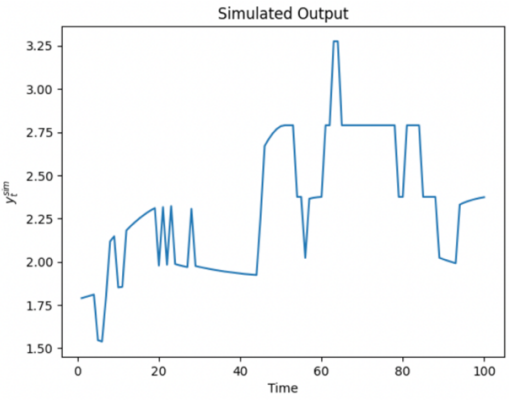


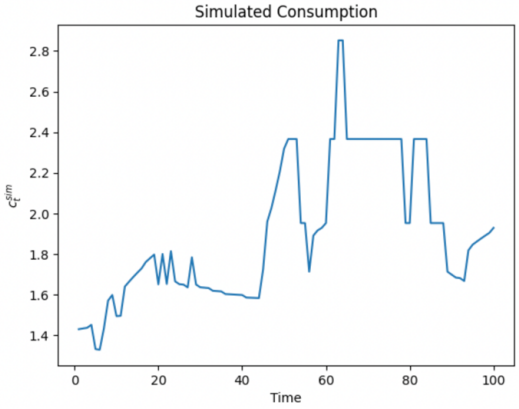


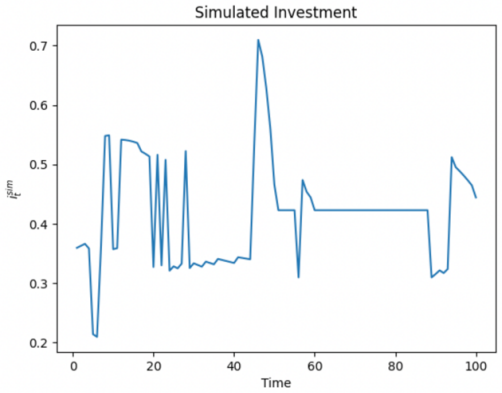


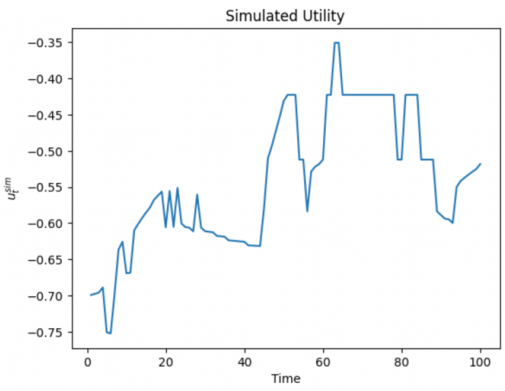


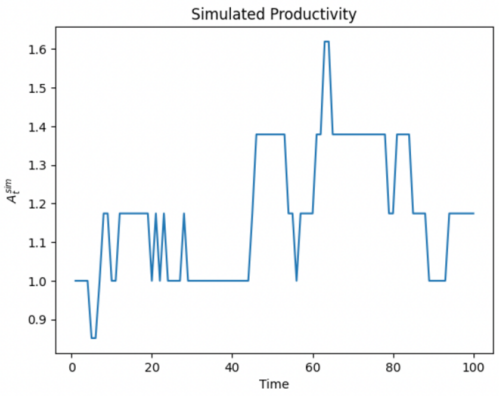

Simulated Capital Choice
k_{t+1}^{sim}
Time

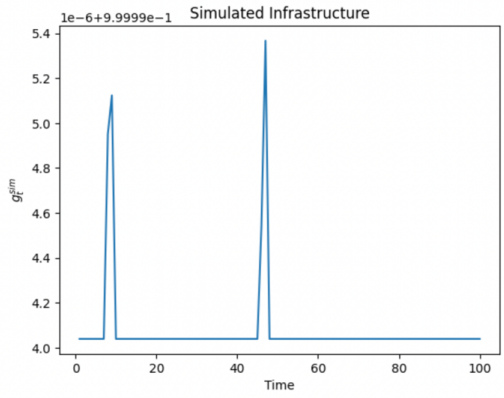

Simulated Output
y_t^{sim}
Time


Simulated Consumption
c_t^{sim}
Time


Simulated Investment
i_t^{sim}
Time


Simulated Utility
u_t^{sim}
Time


Simulated Productivity
A_t^{sim}
Time


Simulated Infrastructure
1e−6+9.9999e−1
g_t^{sim}
Time

As shown in the graphs, we can see the model functions behave similarly to those in the original stochastic growth model. The difference is that infrastructure investment is positively correlated with productivity. Productivity A_t is high and increases after government invests more in infrastructure. Productivity A_t is low when infrastructure investment is delayed or reduced. Given Cobb-Douglas production function with constant returns to scale, the marginal productivity of capital is increasing with infrastructure investment, indicating that g_t positively affect k_t (this shows in public infrastructure policy function graph).

In conclusion, the model suggests that infrastructure investment is an important factor in stimulating economic growth in Ho Chi Minh City, with investment patterns responding dynamically to the changes in productivity and capital stock. However, any delay or incompletion in the public infrastructure projects could also worsen economic growth, leading to delay in intended benefits, reduce investor's confidence and inefficiencies in production and resource allocation. Therefore, the city's new strategy of ramping up public infrastructure investment and accelerating incomplete and delay projects by cutting administrative procedures would be necessary to maintain and stimulate the city's economic growth.

References

Bich Ngoc. (2025, March 7). *Ho Chi Minh City firms call for infrastructure development and public investment*. Vietnam Investment Review - VIR; https://vir.com.vn/. https://vir.com.vn/ho-chi-minh-city-firms-call-for-infrastructure-development-and-public-investment-124042.html

CEICdata.com. (2018). *Vietnam GDP: Ho Chi Minh City (HCMC): ytd*. Ceicdata.com; CEICdata.com. https://www.ceicdata.com/en/vietnam/gross-domestic-product-ho-chi-minh-city-quarterly/gdp-ho-chi-minh-city-hcmc-ytd

Gia Nghi. (2024, December 26). *HCMC's projects 7.1% economic growth for 2024 - The Saigon Times*. The Saigon Times. https://english.thesaigontimes.vn/hcmcs-projects-7-1-economic-growth-for-2024/

Ho Chi Minh City Forecasts Strong Economic Growth for 2024 - Ho Chi Minh Times. (2024). Ho Chi Minh Times. https://hcmtimes.com/ho-chi-minh-city-forecasts-strong-economic-growth-for-2024

Huyền Vy. (2024, August 10). *HCM City strives to gain 2024 growth of 7-8.5%: PM*. Vietnam Economic Times | VnEconomy. https://en.vneconomy.vn/hcm-city-strives-to-gain-2024-growth-of-7-8-5-pm.htm

Vietnam Investment Review. (2024, April 4). *HCM City stimulates tourism with discounts up to 60 per cent*. Vietnam Investment Review - VIR; https://vir.com.vn/. https://vir.com.vn/hcm-city-stimulates-tourism-with-discounts-up-to-60-per-cent-110132.html