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# Public capital and asset prices: Time-series evidence from Japan☆

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## ABSTRACT

This research examines the effects of public infrastructure capital on asset prices in Japan over the period 1983:Q1–2008:Q4. The empirical results show that public infrastructure capital does not forecast stock returns and total factor productivity by the Granger causality test, and the contribution of public investment to stock returns is small based on variance decomposition using the Factor-Augmented vector autoregressive model. Our empirical evidence on the post high-growth era in Japan suggests that public infrastructure investment cannot be expected to play a key role in revitalizing capital markets.

## 1. Introduction

This research examines the effects of public capital on stock prices in Japan. To do so, we performed an empirical investigation using Toda and Yamamoto's (1995) Lag-Augmented vector autoregressive (LAVAR) model for the Granger causality test, and implemented variance decomposition using the Factor-Augmented vector autoregressive (FAVAR) model. We used the return of investment on stock (hereafter, stock returns) to capture the effects on stock prices.[1] Thus, it is expected that the level of stock price may not become stationary even if we take more than first or second differences.

To our knowledge, no previous studies have examined the relationship between public capital and stock prices in Japan. Many works such as those of Kitasaka (1999), Yoshino and Nakajima (1999), Nemoto et al. (1999), and Annala et al. (2008) have examined the macroeconomic effects of public infrastructure capital in Japan. However, these studies have not examined such effects of public infrastructure on stock market performance. Accordingly, our research fills a gap in the literature on Japanese public infrastructure investment policy and the stock market.[2]

Our results are summarized as follows. First, the null hypothesis of no Granger causality from public capital to stock returns and Total Factor Productivity (TFP) cannot be rejected after the collapse of asset price bubbles in the beginning of the 1990s. Second, the movement of public investment can only be a fraction of the movements of stock returns using variance decomposition based on the FAVAR estimation.

Our results imply that public capital (public investment) does not play a key role in the stock market in the post-high-growth

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[1] This is calculated by the following equation: $\left(\frac{Incomegain + Capitalgain}{StockPrice}\right)$.

[2] Fukuda and Yamada (2011) examine the announcement effect of fiscal policy on the stock market using event study. However, their work examines the effect of specific policy events on stock prices and not the effect of public capital or investment itself.

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era Japan. Most previous works in Japan point out that sufficient public capital in Japan had already accumulated at the beginning of our sample periods, reflecting a large amount of public investment in the high-growth era, which led to the low productivity of public capital. Indeed, Yoshino and Nakajima (1999) show that the marginal productivity of public capital in Japan after the 1970s was lower than that before the 1970s on a national level. If the productivity of private companies cannot be enhanced owing to low marginal productivity of public capital, stock prices do not also appreciate. Our results obtained by variance decomposition that quantitative contributions of public investment on stock returns are small may be related to the low productivity of public capital.

This paper is organized as follows. Section 2 presents the theoretical background and testable hypothesis. Section 3 reports the estimation results. Section 4 presents our conclusion.

## 2. Theoretical background and empirical strategies

### 2.1. Theoretical background

Some theories explain that public infrastructure investment affects asset prices through two paths. One is the direct path, which means that public infrastructure investment affects asset prices directly. Fiscal policy is also expected to raise asset prices, as examined in works by Agnello and Sousa (2011) and Nutahara (2013), which show that fiscal stimulus increases the aggregate demand and expected present value of profit (i.e., asset prices). This channel may also be applicable to public infrastructure investment, and we define this as the short-run effect of public infrastructure investment on stock prices.

The other is the indirect path: public capital stock increases the marginal productivity of private enterprises, and thereby raises asset prices. This is examined using both theoretical and empirical models by Belo and Yu (2013). Belo and Yu (2013) assume that public capital is one of the inputs in a firm's production technology and affects the marginal productivity of private inputs. Their theoretical model also shows that if public sector capital increases the marginal productivity of private inputs, there is a positive relationship between the public sector investment rate and the firm's risk premium. This can be defined as the long-term effect of public infrastructure capital (or stock effect) on stock prices.

### 2.2. Empirical strategies and variables used in estimation

We follow two procedures to quantify the relationship between public infrastructure capital and stock prices. First, we perform the Granger causality test to check whether public capital can be used to forecast future stock prices. Second, we check the contribution of the shocks of public investment policy on the fluctuation of stock prices through variance decomposition based on the estimation results by VAR. We capture the direct effect of public infrastructure investment (discussed in Section 2.1) by short-run observations of variance decomposition, and the indirect effect of public infrastructure capital stock (defined in Section 2.1) can be explained by long-run observations of variance decomposition.

To implement variance decomposition, we took differences for public infrastructure capital data both for making the variable stationary and capturing the shocks of public investment policy in the short-run. We used the FAVAR model because this enabled us to purify the shocks of public investment policy by applying principal component analysis for the VAR model considering potential omitted variables as slow moving and fast moving.

## 3. Empirical results

### 3.1. Dataset

The sample period is from the first quarter of 1983 to the fourth quarter of 2008. We use three variables in estimation: stock returns ($R_t$), TFP ($TFP_t$), and government capital stock ($G_t$). TFP is also added because public capital affects stock prices through the increase of private firm's productivity if indirect path shown above is also the case.

Data on stock returns were obtained from the data of stock earnings ratio (Kabushiki toshi shuekiritsu, in Japanese) provided by Japan Securities Research Institute. We calculate TFP following Kamada and Masuda's (2001) procedure.[3] Public infrastructure capital data were extracted from the data calculated by the Cabinet Office in Japan (accessed last May 21, 2016). Incidentally, the official data by the Cabinet Office in Japan offers only annual data. Therefore, we converted the original annual capital stock data into quarterly basis (initial value) data following Kitasaka's (1999) procedure; we did this using the weight for each quarter calculated by the real seasonally adjusted general government gross capital formation data.[4]

The Cabinet Office made public infrastructure capital stock data by considering four types of depreciation: straight-line method, declining-balance method, and the two types of depreciation shown in the OECD's (2009) method. We use all data made by considering different types of depreciation. “G1” is the data made by the straight-line method, “G2” is made by the declining-balance method, and the stock data named “G3a” and “G3b” follow the OECD's (2009) method. As the results are not changed substantially,

[3] For more details on the calculation of TFP, please see the discussion paper version of this paper, which can be downloadable from the website: http://www.econ.kobe-u.ac.jp/activity/publication/dp/pdf/2016/1625.pdf.

[4] For more details, please see Kitasaka (1999).

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