Hong Kong and Singapore: A Comparison of Economies Post-1997

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1 Introduction

Singapore and Hong Kong are two countries located in Asia that are aiming to become the dominant financial hubs in the region. Before the Asian Financial Crisis in 1997, the GDP per capita of these respective countries were about the same. However, following a sequence of events beginning with policy responses to the Crisis in 1997 and ending with the SARS outbreak in 2003, the GDP per capita of Singapore and Hong Kong diverge significantly. Treating the years from 1997 to 2003 as a treatment period in which the "treatment" is the resulting changes in government policy, it is quite clear that the two countries exhibit parallel trends in their GDP per capita figures prior to the treatment period, and differ afterwards (See Figure 1). It has been suggested that differences in government policy between the two countries, specifically in housing and research and development investment, could be responsible for this observation.[1] In this paper, I aim to explore this hypothesis by examining the correlations between %ΔGDP per capita, Construction Share of GDP (see Figure 2), and R&D Share of GDP (see Figure 3) in each respective country using a Vector Error Correction Model (VECM) with lag order 2, and find that while real estate and R&D investment is significantly positively correlated with increased %ΔGDP per capita, the same cannot be said for Hong Kong. Instead, the divergence may be better explained by other factors, such as a lack of investor confidence caused by the handover of Hong Kong from the United Kingdom to the People's Republic of China on July 1st, 1997. Furthermore, due to limitations in the data, we can only examine the investment paths of each country beginning in 2000, when ideally we would have data beginning before 1997 as well.

2 Data and Methods

The GDP per capita figures were obtained from the World Bank (WorldBank, 2024). Annual data on the value of Singapore's construction, R&D investment, and GDP figures were obtained from the Singapore Department of Statistics (DOS, 2024a,b,c). Annual data on the value of Hong Kong's construction, R&D investment, and GDP figures were obtained from the Census and Statistics Department (C&SD, 2024a,b,c). After extracting the relevant data, all figures were normalized to nominal share of GDP (%). In preparation for the VECM, stationary and cointegration tests were performed. Both GDP per capita time series were non-stationary, and so was Singapore's R&D share of GDP. To solve this, the GDP per capita figures were first ran through the Hodrick-Prescott Filter to remove cyclical components, and then converted to percent changes. The Singapore R&D share of GDP data was stationary after differencing once. The optimal lag length was determined by taking one less than the optimal lag length for a VAR model based on Akaike Information Criteria (AIC). After running the model, I also examine the impulse response functions of the relevant variables, and check for Granger causality. All these steps can be found within the code.

[1] Hong Kong reduced its supply of public housing whereas Singapore increased its supply instead, and while both countries began investing more in R&D, Singapore's policy led to a greater and quicker rise in investment. See (Li and Cheung, 2017; Chew, 2016; Wang, 2018) for more info.

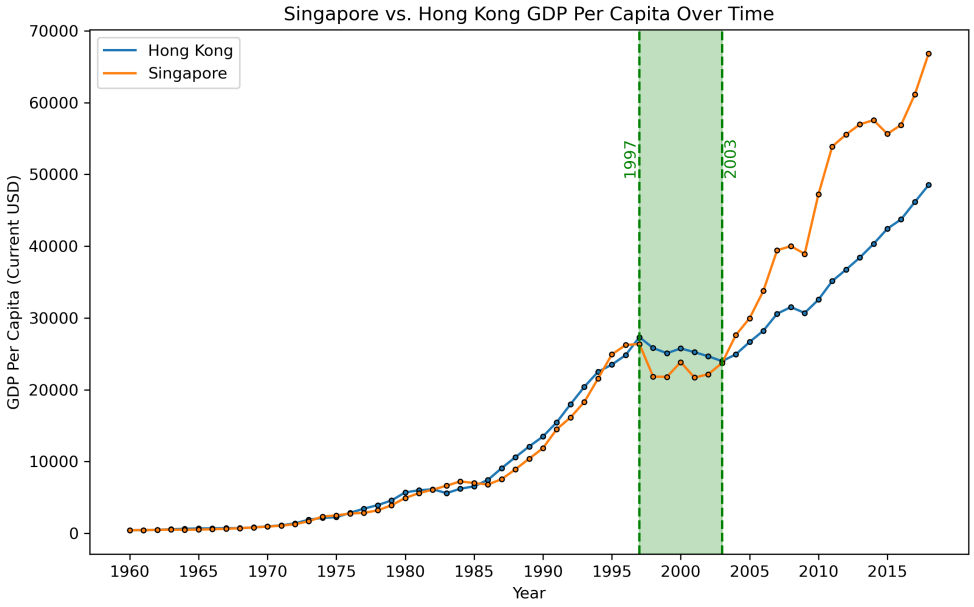

Figure 1: Evidence of Parallel Trends Prior to Period from 1997-2003

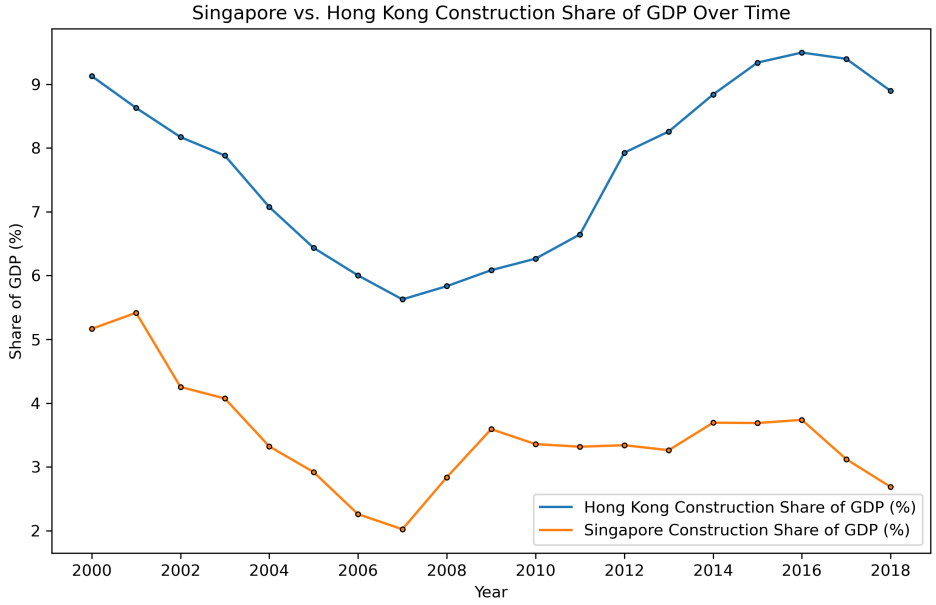

Figure 2: Construction Share of GDP

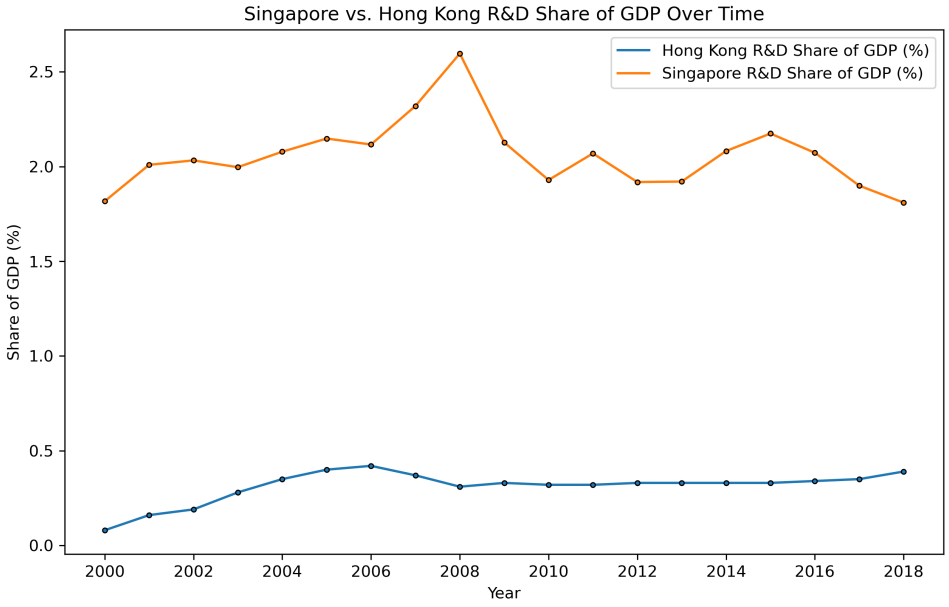

Figure 3: R&D Share of GDP

3 Results

3.1 VECM Coefficient Estimation

The results of the VECM model can be found in the Appendix (section 5). We are interested in equation (5.1.1) and (5.1.2). From equation (5.1.1), we see that for Hong Kong, an increase in previous year investment in construction is negatively correlated with current period percent change in GDP per capita, while R&D investment has a positive correlation. From equation (5.1.2), we see that for Singapore, an increase in both previous year investment in construction and previous year investment in R&D is slightly positively correlated with current period percent change in GDP per capita.

3.2 Impulse Response Functions

To analyze the effect of the different types of investment, the relevant graphs are the top middle and top right graphs of Figure 4 and Figure 5 for Hong Kong and Singapore respectively. The Singapore figures suggest that increases in R&D and real estate investment only slightly affect GDP per capita growth, with R&D investment being slightly negatively correlated, and real estate investment being slightly positively correlated. Hong Kong's figures show negative impacts for real estate investment, but positive impacts from R&D investment.

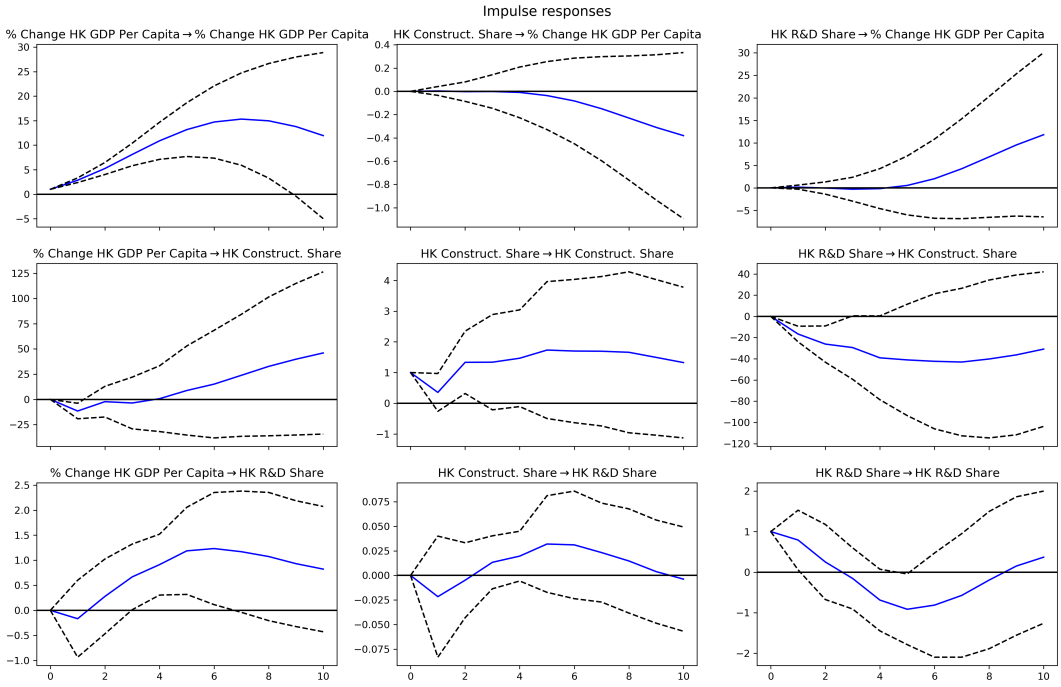

Figure 4: Hong Kong Impulse Response Functions

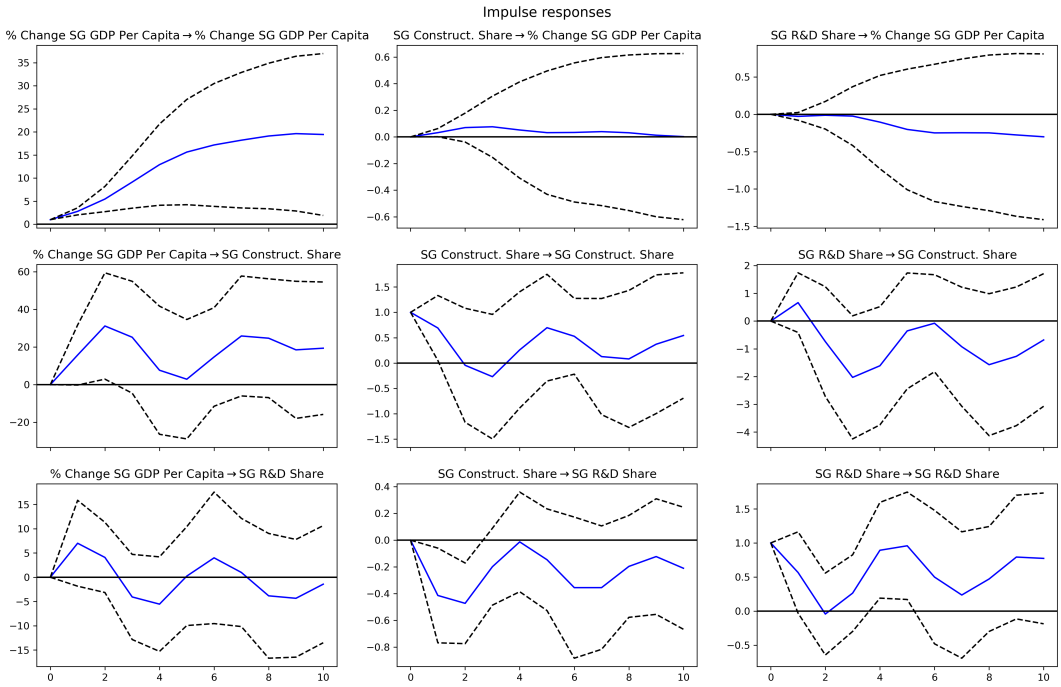

Figure 5: Singapore Impulse Response Functions

3.3 Granger Causality

These results can be found in subsection 5.4 of the Appendix. With the exception of Singapore's R&D investment, all other respective variables' effects on each respective country is causal.

4 Concluding Remarks

The coefficients on equations (5.1.1) and (5.1.2) do seem to line up with expectations based on what each country's government policies were. If we make the reasonable assumption that the production function is concave, that is, it exhibits diminishing marginal returns on each type of investment, Hong Kong's results suggest that on the margin, more R&D investment would be more beneficial, which reflects the fact that Hong Kong has relatively high real estate investment and relatively low R&D investment. Under the same assumptions, Singapore's results suggest that marginally, an increase in real estate investment and R&D investment would have a relatively small impact on GDP per capita growth, suggesting that Singapore's current investment is already high. The impulse response functions also paint a similar picture. These results suggest that Singapore's investment paths in both these sectors are near a steady-state equilibrium, meaning that the government policy was effective in quickly boosting the Singaporian economy to where it is today. Hong Kong, on the other hand, could see significant GDP per capita growth resulting from even more R&D investment. This suggests that Hong Kong's policy response of encouraging R&D investment but not forcing the issue left quite a bit of growth on the table. However, the Granger Causality results throw a wrench in our hypothesis, as it shows that R&D investment in Singapore, what we assumed to be a driving cause of its higher GDP per capita growth, does not Granger-cause the variation in GDP per capita change. This suggests that there may have been other more significant factors driving the difference in the two countries' economies. One possible factor is the handover of Hong Kong to the People's Republic of China from the United Kingdom. One of the leading factors driving foreign investment in Hong Kong was the government's laissez-faire approach to the economy, and the general freedom of markets. Perhaps the handover negatively impacted investor confidence, as would-be investors were put off by the possibility of China attempting to assert more influence over Hong Kong, thus leading to lower levels of investment overall and thus a slower GDP per capita growth rate. Unfortunately, it is impossible to investigate this with the data I have gathered here, because it neither goes back to the year 1997 when the handover occurred, and nor does it have a measure of investor confidence. However, should this data be available, a similar approach (that is, using a VECM model) should suffice to provide insights into how these factors all affect each other.

5 Appendix

5.1 VECM Equations

5.1.1 Hong Kong

Equation for Pct Change HK GDP Per Capita

$$\begin{aligned}\Delta(\text{Pct Change HK GDP Per Capita})_t = {} & 1.8600 \cdot \Delta(\text{Pct Change HK GDP Per Capita})_{t-1} \\ & + 0.0070 \cdot \Delta(\text{HK Construction Share})_{t-1} \\ & - 0.0296 \cdot \Delta(\text{HK R\&D Share})_{t-1} \\ & - 0.9653 \cdot \Delta(\text{Pct Change HK GDP Per Capita})_{t-2} \\ & - 0.0027 \cdot \Delta(\text{HK Construction Share})_{t-2} \\ & - 0.6063 \cdot \Delta(\text{HK R\&D Share})_{t-2}\end{aligned}$$

Equation for HK Construction Share

$$\begin{aligned}\Delta(\text{HK Construction Share})_t = {} & -12.5591 \cdot \Delta(\text{Pct Change HK GDP Per Capita})_{t-1} \\ & - 1.1122 \cdot \Delta(\text{HK Construction Share})_{t-1} \\ & + 7.9625 \cdot \Delta(\text{HK R\&D Share})_{t-1} \\ & + 19.4175 \cdot \Delta(\text{Pct Change HK GDP Per Capita})_{t-2} \\ & - 0.2249 \cdot \Delta(\text{HK Construction Share})_{t-2} \\ & + 2.8063 \cdot \Delta(\text{HK R\&D Share})_{t-2}\end{aligned}$$

Equation for HK R&D Share

$$\begin{aligned}\Delta(\text{HK R\&D Share})_t = {} & -0.2098 \cdot \Delta(\text{Pct Change HK GDP Per Capita})_{t-1} \\ & - 0.0413 \cdot \Delta(\text{HK Construction Share})_{t-1} \\ & + 0.8354 \cdot \Delta(\text{HK R\&D Share})_{t-1} \\ & + 0.4283 \cdot \Delta(\text{Pct Change HK GDP Per Capita})_{t-2} \\ & - 0.0209 \cdot \Delta(\text{HK Construction Share})_{t-2} \\ & + 0.1262 \cdot \Delta(\text{HK R\&D Share})_{t-2}\end{aligned}$$

5.1.2 Singapore

Equation for Pct Change SG GDP Per Capita

$$\begin{aligned}\Delta(\text{Pct Change SG GDP Per Capita})_t = {} & 1.7919 \cdot \Delta(\text{Pct Change SG GDP Per Capita})_{t-1} \\ & + 0.0375 \cdot \Delta(\text{SG Construction Share})_{t-1} \\ & - 0.0208 \cdot \Delta(\text{SG R\&D Share})_{t-1} \\ & - 0.8917 \cdot \Delta(\text{Pct Change SG GDP Per Capita})_{t-2} \\ & - 0.0156 \cdot \Delta(\text{SG Construction Share})_{t-2} \\ & + 0.0386 \cdot \Delta(\text{SG R\&D Share})_{t-2}\end{aligned}$$

Equation for SG Construction Share

$$\begin{aligned}\Delta(\text{SG Construction Share})_t = {} & 14.1134 \cdot \Delta(\text{Pct Change SG GDP Per Capita})_{t-1} \\ & + 0.8209 \cdot \Delta(\text{SG Construction Share})_{t-1} \\ & + 2.0742 \cdot \Delta(\text{SG R\&D Share})_{t-1} \\ & - 14.3389 \cdot \Delta(\text{Pct Change SG GDP Per Capita})_{t-2} \\ & + 0.0698 \cdot \Delta(\text{SG Construction Share})_{t-2} \\ & + 0.9336 \cdot \Delta(\text{SG R\&D Share})_{t-2}\end{aligned}$$

Equation for SG R&D Share

$$\begin{aligned}\Delta(\text{SG R\&D Share})_t = {} & 6.3570 \cdot \Delta(\text{Pct Change SG GDP Per Capita})_{t-1} \\ & + 0.0345 \cdot \Delta(\text{SG Construction Share})_{t-1} \\ & + 0.1271 \cdot \Delta(\text{SG R\&D Share})_{t-1} \\ & - 6.6289 \cdot \Delta(\text{Pct Change SG GDP Per Capita})_{t-2} \\ & - 0.1417 \cdot \Delta(\text{SG Construction Share})_{t-2} \\ & + 0.2328 \cdot \Delta(\text{SG R\&D Share})_{t-2}\end{aligned}$$

5.2 VECM Coefficient Tables

5.2.1 Hong Kong

	Coefficient	Std Err	p-value
L1.Pct Change HK GDP Per Capita	1.8600	0.255	0.000
L1.HK Construction Share	0.0070	0.026	0.784
L1.HK R&D Share	-0.0296	0.278	0.915
L2.Pct Change HK GDP Per Capita	-0.9653	0.328	0.003
L2.HK Construction Share	-0.0027	0.014	0.851
L2.HK R&D Share	-0.6063	0.144	0.000

Table 1: Lagged Endogenous Parameters for Equation Pct Change HK GDP Per Capita

	Coefficient	Std Err	p-value
L1.Pct Change HK GDP Per Capita	-12.5591	4.141	0.002
L1.HK Construction Share	-1.1122	0.416	0.008
L1.HK R&D Share	7.9625	4.516	0.078
L2.Pct Change HK GDP Per Capita	19.4175	5.323	0.000
L2.HK Construction Share	-0.2249	0.233	0.334
L2.HK R&D Share	2.8063	2.342	0.231

Table 2: Lagged Endogenous Parameters for Equation HK Construction Share

	Coefficient	Std Err	p-value
L1.Pct Change HK GDP Per Capita	-0.2098	0.414	0.612
L1.HK Construction Share	-0.0413	0.042	0.321
L1.HK R&D Share	0.8354	0.451	0.064
L2.Pct Change HK GDP Per Capita	0.4283	0.532	0.421
L2.HK Construction Share	-0.0209	0.023	0.369
L2.HK R&D Share	0.1262	0.234	0.590

Table 3: Lagged Endogenous Parameters for Equation HK R&D Share

5.2.2 Singapore

	Coefficient	Std Err	p-value
L1.Pct Change SG GDP Per Capita	1.7919	0.356	0.000
L1.SG Construction Share	0.0375	0.014	0.006
L1.SG R&D Share	-0.0208	0.024	0.394
L2.Pct Change SG GDP Per Capita	-0.8917	0.369	0.016
L2.SG Construction Share	-0.0156	0.009	0.100
L2.SG R&D Share	0.0386	0.036	0.284

Table 4: Lagged Endogenous Parameters for Equation Pct Change SG GDP Per Capita

	Coefficient	Std Err	p-value
L1.Pct Change SG GDP Per Capita	14.1134	7.440	0.058
L1.SG Construction Share	0.8209	0.284	0.004
L1.SG R&D Share	2.0742	0.511	0.000
L2.Pct Change SG GDP Per Capita	-14.3389	7.720	0.063
L2.SG Construction Share	0.0698	0.198	0.725
L2.SG R&D Share	0.9336	0.753	0.215

Table 5: Lagged Endogenous Parameters for Equation SG Construction Share

	Coefficient	Std Err	p-value
L1.Pct Change SG GDP Per Capita	6.3570	4.122	0.123
L1.SG Construction Share	0.0345	0.157	0.827
L1.SG R&D Share	0.1271	0.283	0.654
L2.Pct Change SG GDP Per Capita	-6.6289	4.277	0.121
L2.SG Construction Share	-0.1417	0.110	0.197
L2.SG R&D Share	0.2328	0.417	0.577

Table 6: Lagged Endogenous Parameters for Equation SG R&D Share

5.3 Cointegration Relations

5.3.1 Hong Kong

$$\text{Pct Change HK GDP per Capita} + 0.4615 \times \text{HK Construction Share} - 24.3959 \times \text{HK R\&D Share} = 0$$

5.3.2 Singapore

$$\text{Pct Change SG GDP per Capita} - 0.6908 \times \text{SG Construction Share} - 0.8625 \times \text{SG R\&D Share} = 0$$

5.4 Granger Causality Test Results

5.4.1 Hong Kong

Causality from HK Construction Share to % Change HK GDP Per Capita

Lag	F-statistic	p-value
1	62.9633	0.0000
2	4.2961	0.0418

Table 7: Granger Causality Test Results for % Change HK GDP Per Capita caused by HK Construction Share

Causality from HK R&D Share to % Change HK GDP Per Capita

Lag	F-statistic	p-value
1	6.5606	0.0226
2	13.6913	0.0010

Table 8: Granger Causality Test Results for % Change HK GDP Per Capita caused by HK R&D Share

5.4.2 Singapore

Causality from SG Construction Share to % Change SG GDP Per Capita

Lag	F-statistic	p-value
1	10.3356	0.0062
2	13.2845	0.0012

Table 9: Granger Causality Test Results for % Change SG GDP Per Capita caused by SG Construction Share

Causality from SG R&D Share to % Change SG GDP Per Capita

Lag	F-statistic	p-value
1	2.0210	0.1770
2	1.6842	0.2301

Table 10: Granger Causality Test Results for % Change SG GDP Per Capita caused by SG R&D Share

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