



THOUGHT LEADERSHIP BRIEF

How R&D Spending Affects Productivity in Hong Kong, Shenzhen, and Singapore

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KEY POINTS

- ▶ In Hong Kong, **public R&D spending** has not boosted productivity, **private R&D spending** has boosted productivity, and public R&D spending has spillover effects on private R&D spending
- ▶ In Shenzhen, **public R&D spending** has not boosted productivity, **private R&D spending** has outperformed public R&D spending, and public R&D spending has no spillover effects on private R&D spending
- ▶ In Singapore, **public R&D spending** has boosted productivity, **private R&D spending** has outperformed public R&D spending in boosting productivity, and public R&D spending and private R&D spending have mutual spillover effects

Photo by HKUST Shenzhen Research Institute (SRI)

ISSUE

Technological change through research and development (R&D) fuels economic development and growth. Research shows that R&D spending boosts productivity, but knowledge gaps persist in the literature regarding the effects of distinct types of R&D and their interrelations. I recently participated in a study that addresses these gaps, with particular focus on three local East Asian economic success stories: Hong Kong, Shenzhen, and Singapore.



R&D is carried out in both the public and private sectors. This vital activity ranges from basic research that generates new knowledge to applied research that supports or advances practical objectives to experimental development that generates new products and processes. We assessed the respective contributions to productivity of public R&D spending and private R&D spending in the three abovementioned economies.

We also examined the extent to which R&D spending in the two main economic sectors create “spillovers” – that is, whether and to what extent public R&D spending spurs private R&D spending, and vice versa. These issues informed the three research questions that motivated the study, but we also wanted to compare the effects of R&D spending in Hong Kong, Shenzhen, and Singapore, as these economies represent distinct approaches to development and growth.

To put productivity in perspective, a country with high productivity can yield higher output with a given set of capital and labor resources, enhancing its competitiveness in global markets. For its part, R&D spending represents a factor that can contribute positively to productivity without directly increasing an economy’s stocks of capital or labor.

In summary, we sought to answer three questions: whether there is a positive relationship between R&D spending and productivity in Hong Kong, Shenzhen, and Singapore; whether public or private R&D has a stronger influence on productivity in the three economies; and whether public R&D spending spills over to the private sector by stimulating R&D there (or vice versa). We predicted that we would find that R&D spending would have a statistically significant positive effect on productivity in all three economies, that private R&D spending would have a more immediate and significant impact on productivity than public R&D spending in the three economies, and that in all three cases public R&D spending would spur private R&D spending but private R&D would not have similar effects on public R&D.

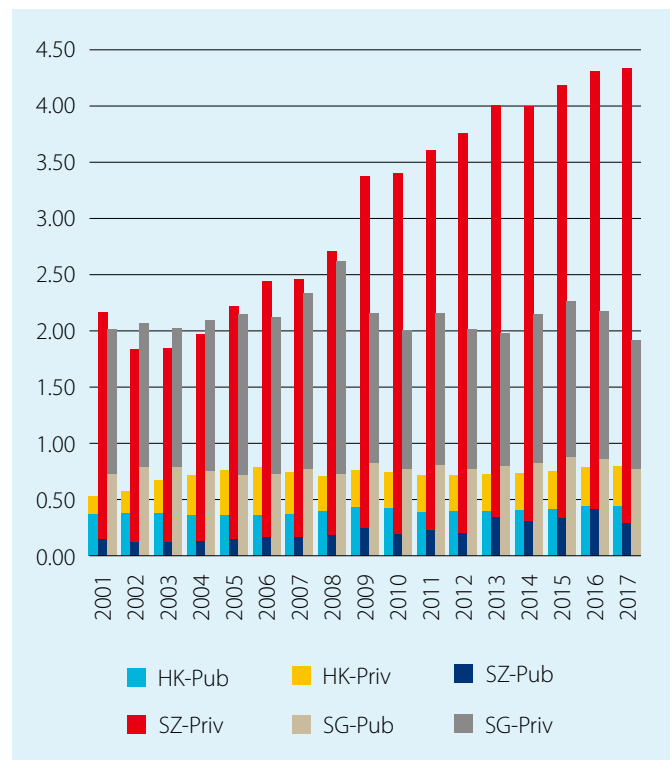
ASSESSMENT

To test our predictions and thereby answer our research questions, we drew on several sources in the three economies in our focus. For Hong Kong, we used the government’s Annual Digest on

Statistics, providing us with data for 1997-2017. For Shenzhen, we used annual Shenzhen Statistical Yearbooks, providing us with data for 2001-2017. For Singapore, we tapped into the Singapore Department of Statistics, providing us with data for 1981-2017. In Figure 1 we compare annual R&D spending in the three economies.

We predicted first that we would find statistically significant positive effects of R&D on productivity in all three economies. Based on our analysis of the data, though, we found mixed results across the three economies. For Hong Kong, we found a positive correlation between R&D and productivity, but only for private R&D. For Shenzhen, though, we found no association between R&D spending – whether total spending or by sector – and productivity. For Singapore, on the other hand, we found positive relationships between total, public, and private R&D spending and productivity.

Figure 1. Year-on-Year R&D spending (as a % of GDP) in Hong Kong, Shenzhen, and Singapore, 2001-2017
 Notes: HK=Hong Kong; SZ=Shenzhen; SG=Singapore; Pub=Public; Priv=Private



Sources: Hong Kong Annual Digest of Statistics 2019, Shenzhen Statistical Yearbook 2018, Singapore Department of Statistics (2020)



We predicted second that we would find a larger positive effect on productivity of public R&D spending than of private R&D spending in the three economies in focus. Here again we found mixed results. For Hong Kong, we found indications of modest effects for public R&D spending, but the figures fell short of statistical significance and are therefore inconclusive. On the other hand, private R&D spending in Hong Kong was found to have positive effects on productivity. For Shenzhen, we found again that private R&D appears to outperform public R&D but none of the results was statistically significant. For Singapore, though, we found that public R&D spending has a stronger effect on productivity than private R&D spending.

We predicted third that public R&D spending would boost private R&D spending but that the reverse would not occur. Our analysis confirmed this prediction for Hong Kong and Singapore, but we found no evidence of positive effects of public R&D spending on private R&D in Shenzhen. On the other hand, contrary to what we expected, we found that in Singapore there was in fact what statisticians call reverse causality, as private R&D spending in the city-state boosted public R&D spending.

Considered broadly, the results we generated through our analysis of R&D spending in Hong Kong, Shenzhen, and Singapore indicate that, when public institutions such as universities and research institutes invest in R&D, the results do not translate universally into direct benefits for productivity. With private R&D, however, we found strong evidence that in some contexts such investments can indeed boost productivity. And the disappointing news for public R&D spending may be softened by the understanding that it often does stimulate additional private R&D spending.

RECOMMENDATION

Our research may strike many readers as disappointing. Given the longstanding belief that innovation and technology fuel economic development and growth, how can R&D spending fail to yield immediate productivity gains? While it may do so in some cases, our data suggest that such an outcome is far from universal. What lessons, then, should the economies in focus in our study take as they consider how best to harness the benefits of R&D to maximize productivity? Our findings point to the need to take up this question on a case-by-case basis.

Hong Kong's economic success story, for example, has much more to do with its capacity to provide critical business and financial services than with its manufacturing engine. Still, although Hong Kong has kept innovation in focus since the handover in 1996, R&D spending remains low relative to that in comparable economies. Perhaps the government has failed to provide enough time for investments in R&D to come to fruition. Moreover, insofar as most public R&D is conducted at universities, a focus on productivity may obscure the real benefits of this activity, which has built up knowledge stocks and generated robust scientific publications. This might explain why private-sector R&D has a better track record in boosting productivity. To address the paltry output of R&D for productivity in Hong Kong, the government could work harder to multiply and strengthen linkages between public and private R&D and extend project lifecycles to allow more time for scientists and managers to implement R&D-fueled initiatives.



Photo by Kelvin Han on Unsplash

For its part, Shenzhen may have focused its R&D spending for too long on experimental development, expending great effort to improve existing products while neglecting basic research. Several studies suggest that experimental R&D functions most effectively when it grows out of or is informed by basic and applied research, which enhance absorptive capacity in firms. The government should identify mechanisms that will enable firms to translate their work in experimental development more effectively, and more quickly, to improve productivity. Moreover, firms in Shenzhen should look to collaborate not only with local research institutions but also with research labs in Hong Kong, which is far better positioned to conduct basis research.

Singapore has arguably outperformed Hong Kong and Shenzhen in leveraging R&D spending to fuel productivity growth, but the city-state's economy has, historically, been dominated by multinational corporations. As a result, local firms have been unable to absorb research that would enable them to generate products they can commercialize successfully. The Singaporean government should therefore consider ways in which to develop absorptive capacity in domestic firms, perhaps by transferring technology from military and public-sector R&D. Singapore, like Hong Kong, would do well to foster linkages between local firms and university and other public research centres.

In summary, the study in focus suggests that, even in vibrant, growing economies like Hong Kong, Shenzhen, and Singapore, R&D spending – especially for public R&D – does not universally enhance productivity. I believe that these economies can strengthen the association between R&D and productivity, though, if they strike the proper balance between laissez-faire and state-led frameworks to generate fruitful interaction between basic, applied, and experimental R&D. Private-sector participation in innovative activities can be induced through funding schemes, grants, or joint collaborations with public research organizations, with the state embracing its capacity to influence the direction of innovation-led growth.



Naubahar Sharif is Professor of Public Policy at The Hong Kong University of Science and Technology (HKUST). His research interests include science, technology and innovation (STI) policy in Hong Kong and within the 'Greater Bay Area' of Southern China; automation in China; and the 'Belt and Road' initiative. In 2011 he completed the Executive Education program in Innovation for Economic Development at Harvard University. At HKUST, Naubahar has been nominated for the Michael G. Gale Medal for Distinguished Teaching, also having won the Interdisciplinary Programs Office's Teaching Excellence Award (in 2020), the School of Humanities and Social Science (SHSS) Best Teacher Award (twice, in 2009 and 2016), and one of his courses was nominated for the Common Core Excellence award. Naubahar has been awarded both 'Public Policy Research' (PPR) and 'General Research Fund' (GRF) grants by Hong Kong's Research Grants Council (RGC). Currently, Naubahar is a co-investigator for two 'Strategic Public Policy Research' (SPPR) grants awarded by Hong Kong's Policy Innovation and Co-ordination Office (PICO) as well as a cross-institutional 'Collaborative Research Fund' (CRF) grant also awarded by the RGC. Naubahar's research has had a demonstrable impact on business and his research was one of HKUST's few 'impact case study' submissions (sole-authored) for its 2020 Research Assessment Exercise (RAE).

Reference:

Naubahar Sharif, Kevin Chandra, Athar Mansoor, and Kirti Bhasin Sinha. "A Comparative Analysis of Research and Development Spending in Hong Kong, Shenzhen, Singapore." *Structural Change and Economic Dynamics* 57 (2021): 108-120.

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