

# A SHIFT-SHARE ANALYSIS OF SINGAPORE'S LABOUR PRODUCTIVITY GROWTH, 1998 – 2013

## EXECUTIVE SUMMARY

- In this article, we examine the drivers of Singapore's labour productivity growth in recent years. Specifically, using shift-share decomposition analysis, we examine whether our sectors have become more productive and whether our industry mix, in terms of employment shares, has shifted towards more productive sectors.
- Between 2008 and 2013, overall productivity growth averaged 1.6 per cent per year, compared to 1.1 per cent per year in the preceding five years. Our decomposition results show that overall productivity growth in the last five years was supported by within-sector improvements in productivity, but was dragged down by a shift in employment towards less productive sectors.
- Specifically, productivity growth in the various sectors contributed 2.3 percentage-points to overall productivity growth each year on average in the last five years, higher than the 1.7 percentage-point contribution each year in the earlier five years.
- However, the employment shares of less productive sectors grew relative to the shares of more productive sectors over the same period, thus dragging down overall productivity growth by 0.4 percentage-points each year. This was larger than the drag on productivity caused by similar negative shifts in the earlier 5-year period from 2003 to 2008 (at 0.2 percentage-points), and a reversal of the positive contribution that a shift in employment towards more productive sectors had between 1998 and 2003.

The views expressed in this paper are solely those of the author and do not necessarily reflect those of the Ministry of Trade and Industry or the Government of Singapore.

## INTRODUCTION

Singapore has embarked on an extensive productivity drive since the start of the decade. This article examines the drivers of productivity growth in Singapore by applying shift-share analysis to decompose productivity growth over the last 15 years. Specifically, the analysis focuses on whether Singapore's productivity trends, especially in the past five years, have been the result of (i) sectors becoming more/less productive, or (ii) more/less productive sectors taking a larger employment share of the economy.

## METHODOLOGY

We adopt a dynamic shift-share methodology to analyse labour productivity growth across three 5-year periods between 1998 and 2013. For each period, overall labour productivity growth in the economy is decomposed into three components:

- Within Effect: the contribution of each sector's productivity growth to overall productivity growth;
- Static Shift Effect: the contribution of changes in the share of workers employed in sectors with *different productivity levels* to overall productivity growth; and
- Dynamic Shift Effect: the contribution of changes in the share of workers employed in sectors with *different productivity growth rates* to overall productivity growth.

Overall productivity growth can then be expressed as the sum of the three components, i.e., *Productivity growth = Within Effect + Static Shift Effect + Dynamic Shift Effect*

In equation form, the shift-share decomposition can be represented as:

$$\frac{P_t - P_{t-1}}{P_{t-1}} = \sum_{i=1}^n \left[ \left( \frac{P_{it} - P_{it-1}}{P_{it-1}} \right) \times \frac{Y_{it-1}}{Y_{t-1}} \right] + \sum_{i=1}^n \left[ \frac{P_{it-1}}{P_{t-1}} \times \left( \frac{L_{it}}{L_t} - \frac{L_{it-1}}{L_{t-1}} \right) \right] + \sum_{i=1}^n \left[ \left( \frac{P_{it} - P_{it-1}}{P_{t-1}} \right) \times \left( \frac{L_{it}}{L_t} - \frac{L_{it-1}}{L_{t-1}} \right) \right]$$

Where  $P_t$  is the productivity level of the economy in period  $t$ ;

$Y_t = \sum_{i=1}^n Y_{it}$  is the total VA of the economy in period  $t$ ;

$L_t = \sum_{i=1}^n L_{it}$  is the total employment of the economy in period  $t$ ; and

$i = 1, \dots, n$  is the  $i$ th sector in the economy.

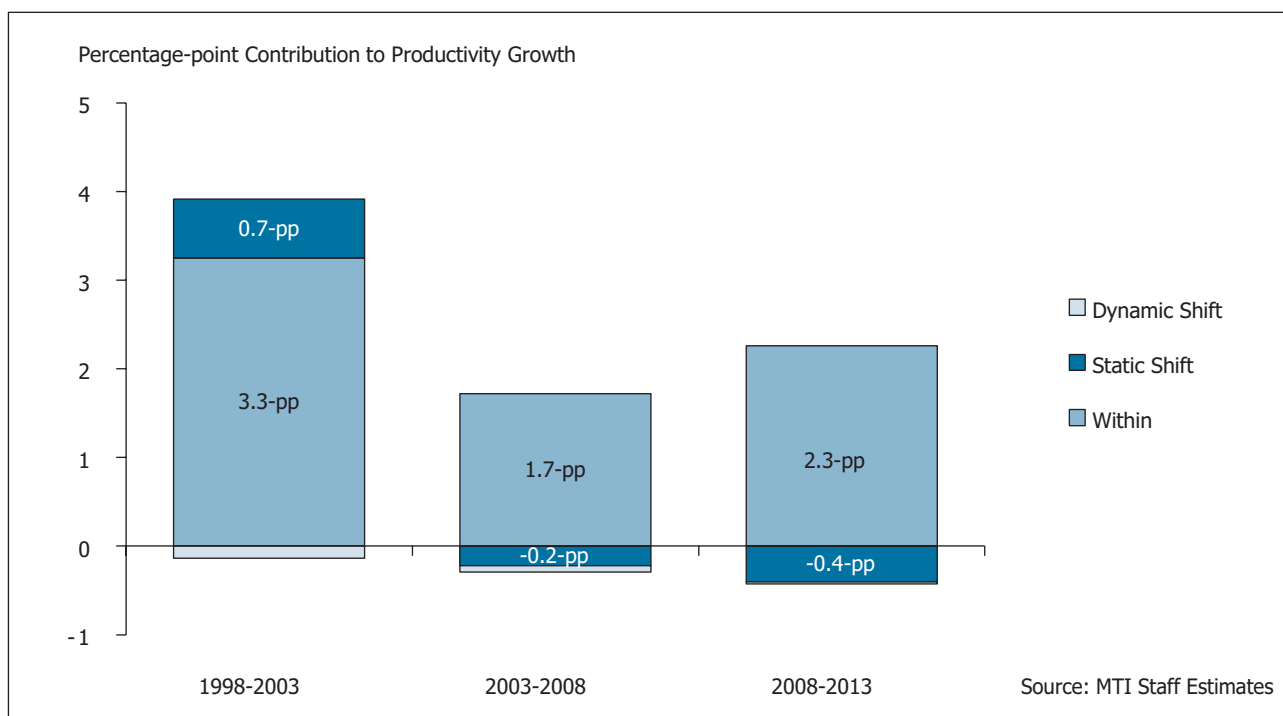
## DECOMPOSITION OF LABOUR PRODUCTIVITY GROWTH

### (a) Overall

Singapore's labour productivity grew by an average of 1.6 per cent per year between 2008 and 2013, higher than the 1.1 per cent per year in the preceding five years.

As can be seen from [Exhibit 1](#), overall labour productivity growth in the latest five-year period was supported by productivity improvements in the various sectors (i.e., positive Within Effect), but weighed down by a shift in employment towards less productive sectors (i.e., negative Static Shift Effect):

- **Within Effect:** Over the last five years, the productivity growth in various sectors contributed 2.3 percentage-points to overall productivity growth each year. This was higher than the 1.7 percentage-point contribution each year in the earlier five years.
- **Static Shift Effect:** However, there was a shift in employment towards less productive sectors in the last five years, with the employment shares of less productive sectors growing relative to that of more productive sectors. The negative Static Shift Effect dragged overall productivity growth down by 0.4 percentage-points each year on average. This was worse than the productivity drag experienced in the preceding 5-year period (-0.2 percentage-points each year on average), and a reversal of the positive Static Shift Effect of 0.7 percentage-points in the earliest 5-year period of 1998 to 2003.
- **Dynamic Shift Effect:** This effect was negligible over the last five years, as well as in earlier periods, with a contribution to overall productivity growth of less than 0.1 percentage-points in the past decade.

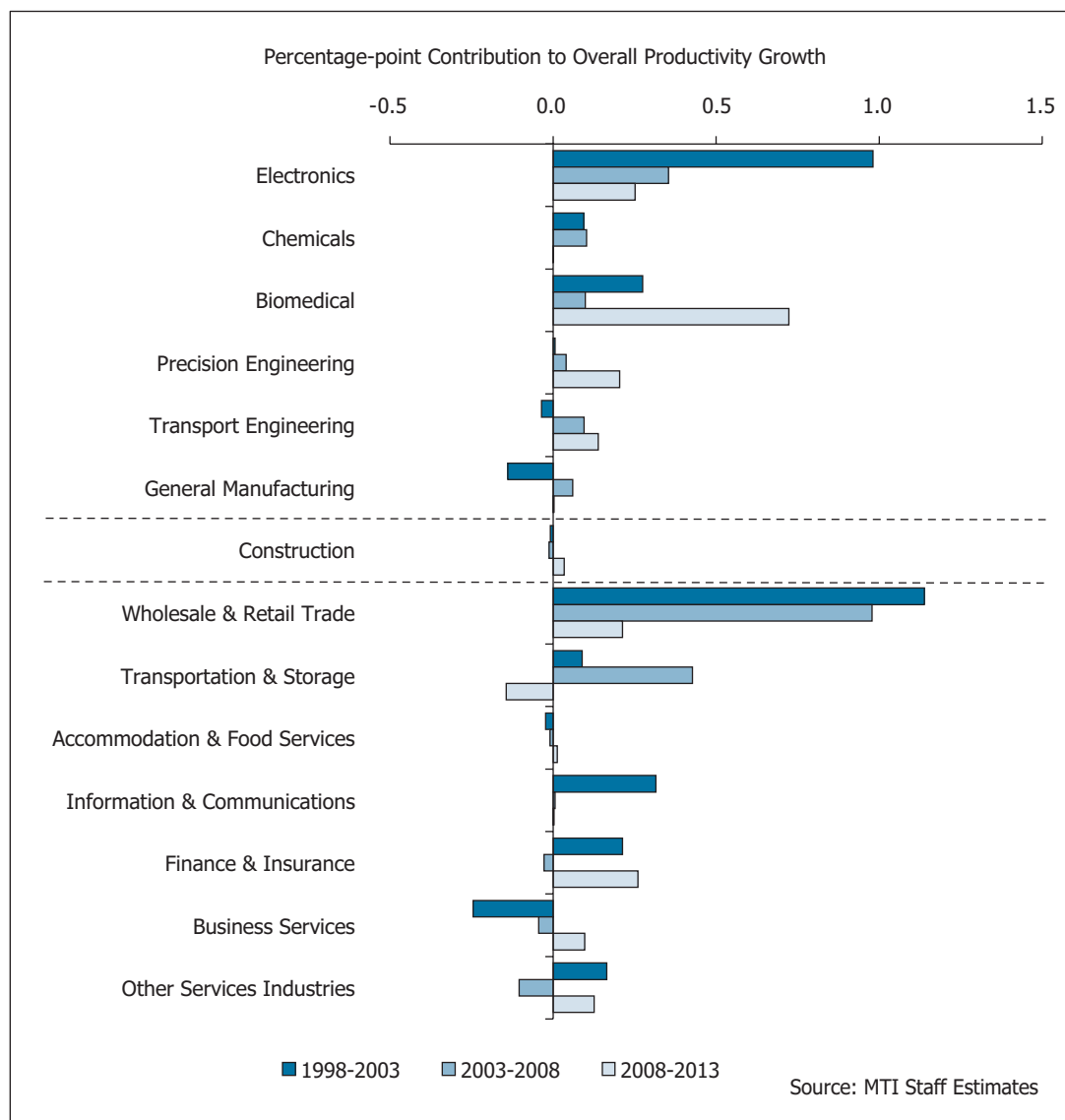
**Exhibit 1: Decomposition of Labour Productivity Growth<sup>1</sup>****(b) Within Effects**

Next, we delve deeper into the contribution of the various sectors to overall productivity growth through within-sector improvements in productivity.

Our key findings are as follows ([Exhibit 2](#)):

- Over the last five years, most sectors achieved positive annual productivity growth on average, thereby contributing positively to overall productivity growth. In particular, the electronics, biomedical manufacturing, precision engineering, transport engineering and finance & insurance sectors saw the highest average annual productivity growth. Collectively, these five sectors contributed 1.6 percentage-points of overall productivity growth per year in the last five years.
- Compared to the previous five years, the higher contribution of within-sector improvements in productivity to overall productivity growth in the last five years came primarily from improvements in productivity growth achieved by sectors such as biomedical manufacturing, precision engineering, finance & insurance, business services and other services sectors.

<sup>1</sup> The contribution from Within Effect, Static Shift Effect and Dynamic Shift Effect do not sum up to overall productivity growth due to the contribution of ownership of dwelling and taxes on products.

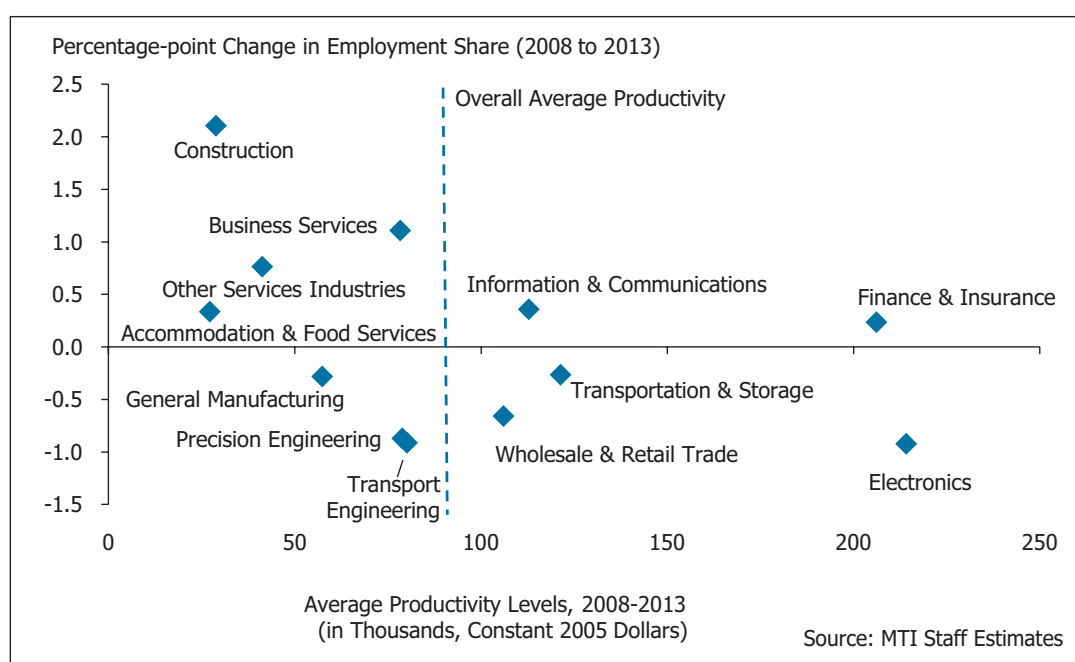
**Exhibit 2: Within Effects by Sectors**

### (c) Static Shift Effects

In terms of Static Shift Effects, we find that in the last five years, employment grew faster in most of the less productive sectors relative to the more productive sectors, thereby pulling down overall productivity performance ([Exhibit 3](#)). Specifically, our findings are as follows:

- The employment shares of several sectors with above-average productivity levels like electronics, transportation & storage, and wholesale & retail trade declined in the last five years. Only two of such sectors – the information & communications and the finance & insurance sectors – saw an increase in their employment shares over this period.
- Conversely, a number of sectors with below-average productivity levels such as construction, business services and accommodation & food services, saw their employment shares rise.

- In particular, a step-up in building and infrastructure projects in recent years has resulted in a substantial expansion of the construction sector. If we exclude the construction sector from our analysis, the negative Static Shift Effect would have been much smaller. In fact, we find that nearly three-quarters of the negative Static Shift Effect in the last five years can be attributed to the expansion of the construction sector. Specifically, about 0.3 percentage-points of productivity growth was lost each year on average in the last five years as a result of the increase in employment share of the construction sector.
- As for the other sectors with below-average productivity levels which saw an increase in employment share (e.g., accommodation & food services) in the last five years, anecdotal feedback suggests that this could partly be due to local employment growth in these sectors, as more Singaporeans have been incentivised by the workfare income supplement (WIS) scheme and other government schemes to join the workforce.
- Compared to the preceding 5-year period, the more negative Static Shift Effect in the last five years was due to faster expansions in the employment of less productive sectors like construction and accommodation & food services. By contrast, the positive Static Shift Effect in the earliest 5-year period from 1998 to 2003 was due to the expansion of productive sectors like biomedical manufacturing and finance & insurance.

**Exhibit 3: Static Shift Effects by Sectors**

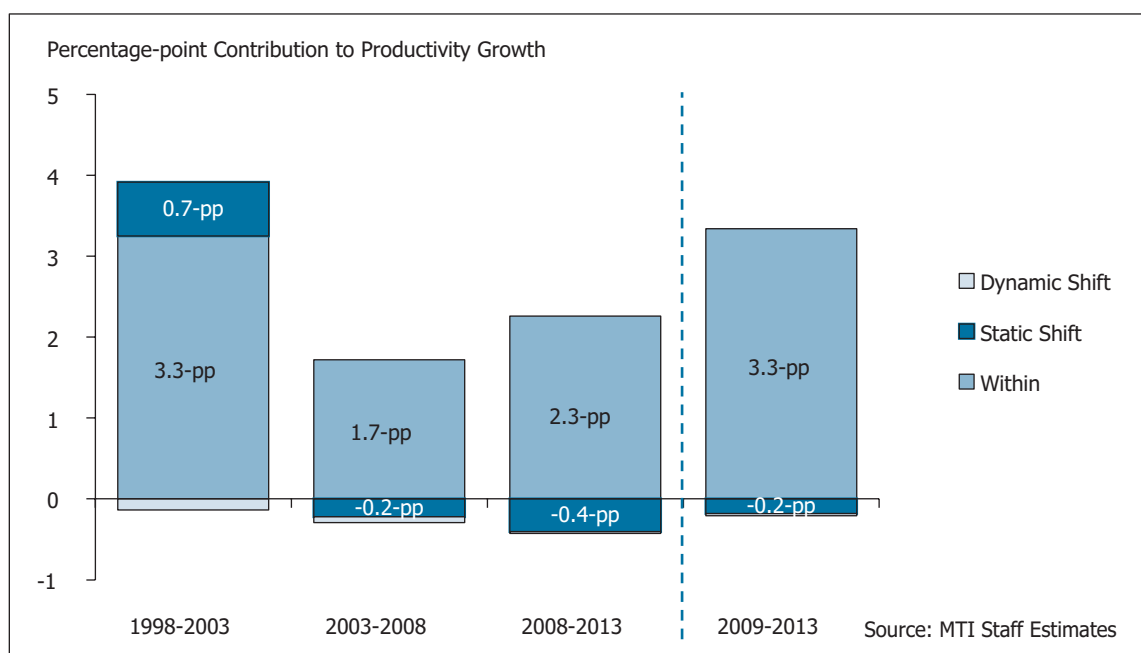
### Box Item: Productivity Trends Since 2009

In February 2010, the Economic Strategies Committee recommended that the economy make a decisive shift towards productivity-driven growth. Later that year, the National Productivity & Continuing Education Council (NPCEC) was set up to drive national efforts to raise productivity.

We thus examine Singapore's productivity growth in the four years since 2009. Over this period, Singapore's labour productivity growth averaged 2.9 per cent per year.<sup>2</sup> In terms of the contribution of the Within and Static Shift Effects, our results are as follows ([Exhibit 4](#)):

- **Within Effect:** Productivity growth in the various sectors contributed 3.3 percentage-points to overall productivity growth each year in the last four years. This was primarily driven by productivity growth in the biomedical manufacturing, precision engineering, transport engineering, wholesale & retail trade, and finance & insurance sectors.
- **Static Shift Effect:** The drag on productivity growth as a result of the expansion of less productive sectors was 0.2 percentage-points each year in the last four years. Similar to the case for the last five years, the negative Static Shift Effect was driven by the increase in employment shares of less productive sectors such as construction and accommodation & food services.

**Exhibit 4: Decomposition of Labour Productivity Growth<sup>3</sup> for 2009-2013**



<sup>2</sup> This is higher than the average productivity growth of 1.6 per cent in the last five years, i.e., between 2008 and 2013, largely because the productivity performance in 2009 was very poor due to the financial crisis.

<sup>3</sup> The contribution from Within Effect, Static Shift Effect and Dynamic Shift Effect do not sum up to overall productivity growth due to the contribution of ownership of dwelling and taxes on products.

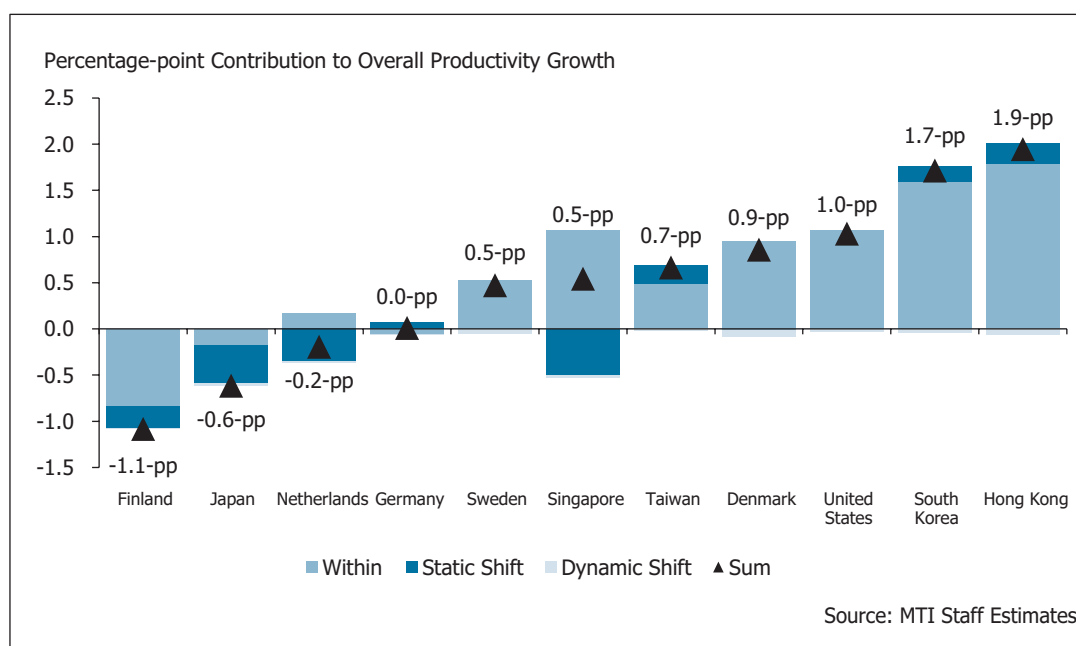
### (d) Cross-Country/Region Comparison of Productivity Drivers

In this section, we compare the drivers of productivity growth across selected developed and Asian economies between 2007 and 2012.<sup>4</sup>

We find that Singapore's Within Effect (1.1 percentage-points) was similar or higher than that of several of the economies surveyed, including the US (1.1 percentage-points), Taiwan (0.5 percentage-points), Germany (-0.1 percentage-points) and Japan (-0.2 percentage-points). However, it was lower than that of Hong Kong (1.8 percentage-points) and South Korea (1.6 percentage-points).

Among the ten economies surveyed, only four experienced negative Static Shift Effects, like Singapore. These include Finland (-0.2 percentage-points) and Japan (-0.4 percentage-points). However, Singapore's negative Static Shift Effect (-0.5 percentage-points) was the largest. By contrast, South Korea, Taiwan and Hong Kong had positive Static Shift Effects of 0.2 percentage-points each. For South Korea and Taiwan, this was largely due to an expansion of its productive business services sector; whereas for Hong Kong, it was the result of the growth of its productive finance & insurance sector.

**Exhibit 5<sup>5</sup>: Decomposition of Labour Productivity Growth for Selected Economies, 2007-2012**



<sup>4</sup> Unlike in earlier sections where we studied productivity growth between 2008 and 2013, we looked at a slightly earlier period 2007 – 2012, as data for 2013 were not available for many economies.

<sup>5</sup> Productivity growth for Japan was for the period 2006 – 2011 as sectoral productivity data for 2012 is not available yet.

## CONCLUSION

Singapore's labour productivity grew faster in the last five years, from 2008 to 2013, as compared to the preceding five years. Overall productivity growth in the last five years was supported by within-sector improvements in most sectors of the Singapore economy. However, faster expansion in the employment of less productive sectors, as compared to more productive sectors, dragged down overall productivity growth. Our results thus suggest that in our efforts to raise productivity, it is important not just to drive sectoral productivity gains, but also to restructure our economy towards more productive sectors.

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