TRADE SPILLOVER EFFECTS ON EAST ASIAN ECONOMIC GROWTH

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Abstract: *Purpose* – This purpose of this study is to investigate the spillover effects of trade on East Asian productivity.

Design/methodology/approach – This study attempts to fill the gaps of previous studies by developing applications of extensive growth theory that show the trade spillover effects on productivity growth of the ASEAN-5 plus-3, namely China, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore and Thailand. It further provides a meaningful statistical analysis in which the first step of the estimation to get the coefficients of the explanatory variables has been used via the econometric approach. In addition, a second step plugs the parameters of the variables into the model in order to compute the contribution rates of productivity indicators including the calculation of the residual of the model (TFP) and GDP contributions used by the growth accounting approach. The TFP is considered a trade spillover effects indicator, which shows the technology transfer to domestic firms and the upgrading of human capital skills.

Findings – The study found that there was a small contribution of exports and imports to TFP growth in these countries during the study period. It confirms that high physical capital input growth resulted in high gross domestic product (GDP) contribution and low TFP contribution with insignificant technological progress experienced by most of these countries, with the exception of Japan and to some extent, South Korea.

Originality/value – The study contributes to gaps left by previous studies in determining that trade spillover effects transferred technology and developed human capital skills to a greater extent in the cases of Japan and the Republic of Korea, and their economies are considered to be productivity-driven.

Keywords: *Trade, Spillover effects, Sustainable productivity growth, East Asian economies*

Paper type Research paper

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INTRODUCTION

Expansion of international trade and investment has triggered the mutual interdependencies of the world's economies, both within the developed economies and between developed and developing economies. The role that the developed economies would play in the sustainable development of the developing economies has never been as important as it is at present (Kawasaki, 2002). Furthermore, the International Monetary Fund (IMF) identifies that even though there was no homogeneous model of development that had been applied throughout East Asia, the integral performance of the booming East Asian economies was an emphasis on stability-oriented macroeconomic policies. Among the plans of these policies were comparatively low inflation and the prevention of overvalued exchange rates; high rates of physical and human capital accumulation; and export-oriented production, which, among other things, significantly encouraged the adoption of advanced technology. Complimentary initial conditions also played a part in that process. More differentiated across countries, and more controversial in their effects, were industrial policies and government intervention (mainly in financial markets) aimed at mobilizing and allocating savings (IMF, 1998).

The IMF further affirms that empirical estimates of the contributions of factor inputs and total factor productivity (TFP) growth to East Asian economies' output growth had fallen in a wide range, with capital accumulation generally found to have made the largest contribution. Productivity growth was found to have made smaller but still significant contributions. Accordingly, a recent study of the IMF found that during 1960–94 in all four of the Asian newly industrialized economies and the three fast growing Association of South East Nations (ASEAN) economies, i.e. Indonesia, Malaysia and Thailand, the contribution of capital deepening (capital per worker) dominated growth in factor productivity in explaining growth in labour productivity (output per worker). Since the early 1980s, on the other hand, TFP growth appeared to have played a larger role. For example, in Singapore, TFP growth was approximately 1 per cent a year during the periods 1960–73 and 1973–84, correspondingly, but rose to more than 3 per cent a year during 1984–94. Likewise, in Thailand, TFP growth was 1.25 per cent a year during 1960–84, but rose to 3.25 per cent a year in the subsequent ten years. These results may be compared with the experience of the industrial countries during 1960–94, although rates of growth in output per worker

in the East Asian economies were significantly higher than in the industrial countries, (the exception is the Philippines, where according to most estimates and time periods, productivity growth made little, or even a negative, contribution to output growth). The contributions of TFP growth were markedly higher only in a few cases, including China, Taiwan and Thailand, despite the Asian economies' lower initial levels of technological development. Compared with the TFP growth of European economies and Japan during their fast catch-up years in the 1950s and 1960s, TFP growth in the East Asian economies has been much less rapid. However, no other group of developing countries has done as well as the East Asian economies.

As has been mentioned by Mahadevan (2007), there are various points of view in the literature for the quest of an export-oriented development strategy. First, trade expansion will bring about productivity through greater economies of scale in the export sector, thereby leading to a reallocation of resources from the relatively inefficient non-trade sector to the highly productive export sector. Exports allow for specialisation based on comparative and competitive advantages allowing an increase in GDP. Second, an outward-oriented trade policy may give access to advanced technologies, "learning-by-doing" gains and better management practices that may result in further productivity gains. Third, increased export earnings will relieve constraints on growth by enhancing the capacity to import essential goods in the form of intermediate and capital goods. Therefore, export expansion promotes capital accumulation and consequently economic growth. Fourth, an export-oriented approach such as that in the East Asian countries has allowed rapid expansion of employment and real wages, leading to domestic spending as another source of GDP growth (Athukorala and Menon, 1996).

METHODOLOGY AND ESTIMATION PROCEDURES

In this study, Cobb-Douglas production function econometric estimation and the Solow's residual of growth accounting nonparametric analysis have been used as a modified model to fill the gaps of both estimations, which had previously cast doubts on the results generated.

The modified production function in this research has followed the conventional growth accounting framework utilised by Stigler (1947), Abramovitz (1956), and Kendrick (1956). This approach was initially developed by Solow (1956, 1957), finally brought to fruition by

Kendrick (1961) and further refined by Denison (1962, 1979), Griliches and Jorgenson (1962), Jorgenson *et al.*, (1987), Dewan and Kraemer (2000), used by Lee and Khatri (2003) and modified by Elsadig (2006). This approach provides wider space for decomposition of contributions of factor inputs and technological change to economic growth. This study thus develops the combined Cobb-Douglas production function and growth accounting framework in two steps. It provides empirical evidence on the contributions of aggregate physical capital, human capital, exports and imports to Gross Domestic Product (GDP) growth and their quality combined contribution as spillover effects indictor (TFP) for a group of developed and developing countries, including the ASEAN-5 plus-3 countries.

Production function is given in Equation (1):

$$\text{GDPit} = F(\text{Kit, HCit; Xit; Mit, Tit}) \tag{1}$$

where for Country i = 1, 2, …, 8 in Year t =1965–2006, the output GDP_{it} is real annual GDP, and the inputs are: real aggregate physical capital K_{it}, human capital (number of persons employed) Lit, exports Xit, imports Mit and time T_{it}, that proxies for total factor productivity (TFP) as a technological progress of these countries.

The Cobb-Douglas production function for Country i (i = 1, 2, …, 8) in Year t (t = 1965–2006) is given in Equation (2):

$$\Delta\ln\text{GDPit} = a + \alpha.\Delta\ln\text{Kit} + \beta.\Delta\ln\text{HCit} + \lambda.\Delta\ln\text{Xit} + \theta.\Delta\ln\text{Mit} + \varepsilon\text{it} \tag{2}$$

where
  α is the output elasticity with respect to aggregate physical capital
  β is the output elasticity with respect to human capital
  λ is the output elasticity with respect to exports
  θ is the output elasticity with respect to imports
  a   is the intercept or constant of the model[2]
  ε_{it} is the residual term[3]
  ln   is the log to transform the variables
  Δ is the difference operator denoting proportionate change rate

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[2]The intercept term, as usual, gives the mean or average effect on dependent variable of all the variables excluded from the model.
[3]The residual term proxies for the total factor productivity growth that accounts for the technological progress of the economy through the quality of input terms.

ε_{it} is the random error term in the model, representing the net influence of all unmeasured factors. This is explained as the combination of the quality of the inputs involved, those proxies for the TFP growth, which is considered to be a trade spillover effect in this study.

Equation (2) is based on econometric estimation which contained a gap due to its basis on the coefficients of the estimated explanatory variables (those considered as homogenous measures of the explanatory variables). The major drawback in this model is that it does not provide the contributions of productivity indicators of these explanatory variables to explain the productivity performance as done by growth accounting, which in itself represents the gap of failing to show the parameters of the explanatory variables and statistical test to display the reliability of results generated. According to Mahadevan (2001), the TFP growth studies on the Malaysian manufacturing sector have used the nonparametric translog-divisia index approach developed by Jorgenson *et al.* (1987). She has noted that this approach does not require the explicit specification of a production function, but the major drawback is that it is not based on statistical theory and hence, statistical methods cannot be applied to evaluate their reliabilities, thus casting doubt on their results.

In this respect, this study effectively attempts to fill the gap of the divisia translog index approach that was developed by Jorgenson *et al* (1987). Therefore, the current study provides a statistical analysis for estimating the coefficients of the explanatory variables that have been used by the econometric approach (Equation 2). These coefficients were substituted into the model (Equation 3). The divisia translog index approach was then used to calculate the growth rates and the contributions of productivity indicators, which include the calculation of the residual of the model that is named TFP growth (trade spillover effects pointer) and the output growth that were used by the growth accounting approach.

The paper endeavours to apply the conventional growth accounting framework as modified by Elsadig (2006, 2008). This approach provides wider space for decomposition of contributions of factor inputs and technological change to economic growth. This study thus develops a combined model of both parametric and nonparametric analysis to fill the gaps in both models.

The intercept (a) in Equation 2 has no place in the calculation of the productivity growth indicators. That is not considered in the

second step, which calculates the growth rates of productivity indicators transforming equation [2] as an extension of the basic growth accounting framework, the production function is specified in the parametric form of the above equation as follows:

$$\Delta \ln TFP_{it} = \Delta \ln GDP_{it} - [\alpha. \Delta \ln K_{it} + \beta. \Delta \ln HC_{it} + \lambda. \Delta \ln X_{it} + \theta. \Delta \ln M_{it}] \quad (3)$$

where the weights are given by the average value shares as follows:

$\Delta \ln GDP_{it}$	is the contribution rate of output
$\alpha. \Delta \ln K_{it}$	is the contribution of the aggregatel physical capital
$\beta. \Delta \ln L_{it}$	is the contribuion of the human capital
$\lambda. \Delta \ln X_{it}$	is the contribution of the exports
$\theta \Delta \ln X_{it}$	is the contribution of the imports
$\Delta \ln TFP_{it}$	is the total factor productivity growth contribution

The framework decomposes the share of GDP into the contributions of the rates of growth of the aggregate physical capital, human capital, exports and imports, plus a residual term typically referred to as the contribution of TFP (trade spillover effects indicator).

SOURCES OF DATA

The data used in this study consist of real GDP, real aggregate fixed physical capital and real exports and imports. Those transformed to real data based on 2000 as the base year, and number of employment were collected mainly from international financial statistics of International Monetary Fund online database and the World Development indictors of the World Bank. The missing data is validated with the data from the individual countries' databases, Asian Development Bank: Key indicators of developing Asia and Pacific countries, Statistical and Data Systems Division, and the International Labour Organization for the period of 1965–2006. Due to lack of data on man-hours of work, the labour input index is constructed based on the number of persons employed, which is considered a good measure of human capital. Moreover, following Mahadevan (2007), GDP is adjusted to exclude the components of trade; both exports and imports shares are found to have an outstanding influence on GDP growth. These feedback links are further strengthened by a two-way relationship between the growth of imports and exports (Mahadevan, 2007). It has been documented in the literature (Mahadevan, 2007), that a high level of intra-industry trade

is associated with imports and exports moving together (Bernard and
Jensen, 2004).

RESULTS AND DISCUSSION

An autoregressive estimator has been applied to Equation 2 of the model
generated from the Cobb-Douglas production function to measure the
shift in the production functions of ASEAN-5 plus-3. Annual time series
data over the period of 1965–2006 for real GDP, aggregate psychical
capital, number of employment, real exports and real imports have been
employed for the individual countries.

In view of the fact that the model used in this study is specified in
first differences and the calculated growth rates are used in the discussion
of results and findings of the study, the model is found to be stationary.
In addition, Table 1 presents the results of the unit root tests conducted.
Likewise, Engle and Granger (2003) stated that if economic relationships
are specified in first differences instead of levels, the statistical difficulties

Country	GDP	Capital	Labour	Exports	Imports
1. China	-6.26*	-6.13*	-6.32*	-3.90*	-4.42*
	-6.25**	-6.15**	-6.24**	-4.06**	-4.43**
2. Indonesia	-3.34*	-4.00*	-7.17*	-3.24*	-3.01*
	-3.89**	-4.59**	-7.07**	-3.48**	-2.45**
3. Japan	-1.53*	-2.42*	-4.75*	-4.66*	-4.56*
	-3.67**	-3.72**	-6.01**	-4.19**	-4.54**
4. Korea	-2.30*	-3.65*	-6.14*	-3.59*	-3.89*
	-3.90**	-4.81**	-6.06**	-4.44*	-5.13**
5. Malaysia	-5.16*	-4.08*	-6.34*	-2.96*	-2.96*
	-5.11**	-4.13**	-6.26**	-2.89**	-3.13**
6.. Philippines	-4.91*	-4.37*	-6.26*	-2.51*	-2.17*
	-5.50**	-4.82**	-6.19**	-2.88**	-2.87**
7. Singapore	-3.46*	-2.92*	-6.07*	-2.51*	-2..47*
	-4.31**	-3.78**	-6.29**	-2.94**	-3.04**
8. Thailand	-3.51*	-3.48*	-6.27*	-2.36*	-2.37*
	-3.67**	-3.55**	-6.25**	-3.11**	-3.05**

Table 1:
Results of the
Phillips-Perron (PP)
Unit Root Test First
Difference

Notes: Figures in Table 1 are T test-values showing significance at 1%, 5% and 10%
* Constant without trend
** Constant with trend

Country	Intercept	Capital	Labour	Exports	Imports	Adju.R2	D-W
1. China	0.13 (0.46)	0.82 (17.3)**	0.10 (1.42)	0.15 (1.80)*	-0.08 (-1.35)	0.91	1.99
2. Indonesia	1.35 (0.20)	0.22 (1.96)**	0.13 (1.11)	0.21 (1.78)*	0.24 (2.80)**	0.94	1.97
3. Japan	0.57 (0.11)	0.75 (13.1)**	0.11 (1.39)	0.29 (5.55)**	-0.17 (-.79)**	0.95	1.96
4. Korea	1.33 (10.9)**	0.32 (3.34)**	0.10 (5.11)**	-0.08 (-1.01)**	0.65 (4.56)**	0.92	1.93
5. Malaysia	0.83 (1.55)	0.36 (4.90)**	0.01 (1.14)**	0.74 (7.16)**	-0.12* (-1.84)	0.90	1.96
6. Philippines	1.12 (3.95)**	0.73 (3.87)**	0.11 (3.10)**	0.42 (2.81)**	-0.28 (-1.18)	0.95	1.92
7. Singapore	1.43 (1.28)	0.36 (6.39)**	0.31 (1.54)	0.29 (2.61)**	0.03	0.93	1.95
8. Thailand	1.11 (3..10)**	0.60 (5.90)**	0.04 (1.70)*	0.60 (6.46)**	-0.25 (-1.83)*	0.94	1.88

Notes: Figures in parentheses are t-values
** Significant at 5% level
* Significant at 10% level

Table 2: Estimated coefficients of ASEAN 5 + 3 1965-2006

due to non-stationary variables can be avoided because the differenced variables are usually stationary even if the original variables are not.

Analysis of the data using Equation 2 has shown that the estimated coefficients of the explanatory variables of the model are significant at 5 per cent and 10 per cent levels. According to Durbin-Watson (D-W) values, the model has no problem of autocorrelation (Table 2).

Figures in Table 2 were estimated using equation (2)

Empirical analysis

This section uses a constructive analysis to compare the productivity indicators between the ASEAN-5 plus-3 economies for the entire period of 1965–2006. In order to study the effect of governments' policies in improving the productivity growth, the study period was divided into two phases. These phases, which corresponded to the major policy changes, were 1965–1987 and 1988–2006. The period of the 1960s and 1970s witnessed the labour-driven policies in these countries and the birth of a new era of export-oriented economies. The decades of the 1980s,

1990s and 2000s saw a further diversification of the economies of these countries into more advanced industries through investment-driven policies and trade liberalisation that attracted foreign direct investment (FDI), which was brought to these countries through Transnational Corporations (TNCs), investment. As a result of these polices, the range of economic activities and sources of growth became more diversified. During these decades, economic structural transformation took place in most of these economies and the manufacturing sector became the engine of growth. The analysis finally includes the period of 1988–2006, i.e. the period before and after the Asian financial crisis of 1997.

However, by including the exports and imports in the model in the economies of these countries in terms of average annual productivity growth, the contribution of TFP growth (as a trade spillover effects indicator) was slight (Table 3). Comparing the Japanese and Korean Models of economic development with other Asian countries, the TFP contribution of this study has shown that there is no significant difference between these countries when exports and imports are included. Japan, and to some extent Korea, had developed productivity-driven economies with technological progress. Other Asian countries gained the chance to develop their economies through input-driven processes without making significant technological progress. Korea has developed a significant knowledge stoke that enabled the development of such companies as Daewoo, Samsung and LG, which compete globally. This means that Japan and Korea had significant trade spillover effects and those of the rest of the ASEAN countries were insignificant when considering the TFP contributions.

The highest contribution of GDP when including exports and imports in the model to the productivity growth of the ASEAN-5 plus-3 is observed during the sub periods of 1987–2006 and 1988–2006 (Table 3). The sub-period of 1965–1987 is found to be a combined period of labour and investment-driven policies. In contrast, the sub period of 1988–2006 is the perceived period of investment, driven with particular focus on ICT and human capital development. As a result, the performance of the economies of these countries was rapid compared with the period before their transformation into investment-driven economies that had been supported by foreign direct investment (FDI). The TFP growth contribution was low and not remarkable in its contribution to the economy's productivity growth. The reasons behind this were the economic recession of 1973,

1985, the financial crisis of 1997, the quality of human capital and the technology involved in the production of these economies, with the exception of Japan and Korea.

The highest contribution of aggregate physical capital to GDP in terms of average annual productivity growth of the ASEAN-5 plus-3 was made during the sub-period of 1987–2006. Likewise, the contribution of aggregate labour to GDP in terms of average annual productivity growth of these countries was found to be fair during all the periods of the study (Table 3). This reflects the fact of the comparative advantage in unskilled labour intensity that eventually helped these countries to attract FDI in the latter half of the 1980s. These countries accelerated trade liberalisation policies and drastically eased restrictions with respect to capital ownership of foreign companies. This fostered the significant inflow of global capital.

Finally, the contribution of exports and imports to the economies of ASEAN-5 plus-3 is robustly significant among the input terms during most of the periods of the study. By examining the role of exports and imports to achieve productivity-driven economies through TFP growth, the results showed that there was a small contribution of exports and imports to the TFP growth of the economies of these countries during all the periods of study (Table 3).

Despite the claims of Athukorala and Menon (1996) that are cited by Mahadevan (2007), trade expansion will bring about productivity through greater economies of scale in the export sector, thereby leading to a more highly productive export sector. This study found that exports and imports have no significant effect on productivity as presented in the TFP results when exports and imports are included in the model (Table 3). TNCs invested in these countries are importing their inputs and exporting their products; these countries are collecting the taxes and employing their people in these TNCs. Meanwhile, FDI is considered to be the source of technology transfer to these countries through TNCs and investment, but there is no evidence of productivity-driven efforts in most cases. However, Japan and Korea were considered to be productivity-driven economies among these countries; this is supported by the fact that these two countries have their own TNCs invested both at home and abroad. In this regard, the trade spillover effects are insignificantly affecting the ASEAN countries in terms of technology transfer and the upgrading of human capital skills.

These findings are in line with those of Mahadevan (2007), and Robert and David (1999); both studies found that TFP growth has no significant effect on exports or imports growth in some of these countries, including Japan, Korea and Malaysia. However, their findings should be read in the particular context that exports and imports have no significant contribution to the TFP of these countries, rather than the fact that TFP has no significant effect on export or import growth. TFP measures the relationship between output and its total inputs (a weighted sum of all inputs), by this means giving the residual output

Country	GDP	Capital	Labour	Exports	Imports	TFP
China						
1965-2006	7.34	6.17	13.2	10.4	10.4	1.40
1965-1987	6.12	4.87	13.0	9.05	9.05	1.07
1988-2006	8.76	7.66	13.4	12.09	12.01	1.78
Indonesia						
1965-2006	11.3	10.3	11.0	9.94	9.91	1.35
1965-1987	9.56	8.90	10.8	7.92	7.95	1.36
1988-2006	13.4	12.1	11.36	12.2	12.2	1.34
Japan						
1965-2006	12.4	11.2	17.9	10.2	10.1	1.57
1965-1987	11.9	10.7	17.8	9.78	9.65	1.46
1988-2006	13.0	11.7	17.9	10.8	10.7	1.70
Korea						
1965-2006	11.0	9.85	8.32	9.82	9.93	1.33
1965-1987	9.49	8.11	6.94	8.07	8.31	1.34
1988-2006	12.9	11.8	9.91	11.8	11.8	1.31
Malaysia						
1965-2006	11.2	9.91	6.56	10.8	10.7	0.79
1965-1987	10.2	8.83	4.45	9.56	9.48	1.04
1988-2006	12.4	11.2	9.01	12.3	12.3	0.49
Philippines						
1965-2006	6.22	4.60	8.89	4.91	5.02	1.09
1965-1987	4.90	3.30	7.78	3.25	3.37	1.11
1988-2006	7.75	6.12	10.1	6.84	6.94	1.07
Singapore						
1965-2006	10.5	9.43	7.11	10.7	10.9	1.42
1965-1987	9.57	8.51	6.79	9.68	9.96	1.22
1988-2006	11.7	10.5	7.48	12.1	12.1	1.64
Thailand						
1965-2006	7.01	5.72	9.29	5.83	5.91	1.12
1965-1987	5.90	4.51	8.34	4.32	4.46	1.33
1988-2006	8.29	7.12	10.4	7.59	7.58	0.87

Table 3:
ASEAN 5 + 3
Productivity
indicators
(in percentage)

Note: Figures in Table 3 were calculated using equation (3).

changes that are not accounted for by total factor inputs changes. Being a residual, changes in TFP are not influenced by changes in the various factors affecting technological progress, such as the quality of factors of production, flexibility of resource use, capacity utilisation, quality of management, economies of scale, and the like (Rao and Preston, 1984). These characteristics of TFP qualified it to be considered as the trade spillover effects indicator that would transfer technology to local firms and help in upgrading local human capital skills.

In addition, as mentioned earlier, it has been documented in empirical work on economic growth by Solow (1956, 1957), that after accounting for physical and human capital accumulation, "something else" accounts for the bulk of output growth in most countries. Both physical and human capital accumulations are certainly critical for economic growth. In this regard, a vital question arises: is it the quality of exports and imports that makes the difference and determines the TFP contribution? Or so-called "learning by doing", and in this case, is it "learning by exporting and importing"? The answer to this question is that the trade spillover effects make the difference in Japan and Korea, so that they are productivity-driven economies and the ASEAN countries are input-driven economies.

CONCLUSION

This study attempts to fill the gaps left by previous studies by developing applications of extensive growth theory that reveal the trade spillover effects on productivity growth of the ASEAN-5 plus-3. It further provides a meaningful statistical analysis in which the first step of the estimation involves determining the coefficients of the explanatory variables that have been used by the econometric approach. It can be restated here that in addition, a second step involves plugging the parameters of the variables into the model in order to compute the contribution rates of productivity indicators, including the calculation of the residual of the model (TFP) and GDP contributions used by the growth accounting approach. The TFP is considered a trade spillover effects indicator that shows the technology transfer to domestic firms and the upgrading of human capital skills.

The study found that the impact of exports and imports is positive with insignificant contribution to TFP growth. These findings are in line with those of Mahadevan (2007), and Robert and David (1999), in that

both studies state that TFP growth has no significant effect on import or export growth in some of these countries, including Japan, Korea and Malaysia. Conversely, their findings should be placed in the accurate concept that exports and imports have no significant contribution to the TFP of these countries; furthermore, it is not the TFP that has no significant effect on exports or imports growth. In fact, it is the quality of exports and imports that create the difference and determine the TFP contribution. In this study, so-called "learning by doing" is "learning by exporting and importing". At this point, is it the trade spillover effects concept that should be considered?

These results also confirm the concept that exports and imports had a very significant role in achieving the higher GDP contribution that is produced by these economies through using huge inputs to produce output. FDI helped the manufacturing sector to become the engine of economic growth rather than the agricultural sector when economic structural transformation took place in these economies in the 1980s, with the exception of Japan, whose economic structural transformation occurred in the 1970s. Nevertheless, Japan and Korea were considered to be productivity-driven economies among these countries. This is supported by the evidence; these two countries have their own TNCs invested, both at home and abroad.

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