

Impact of population ageing on productivity growth in Hong Kong

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Abstract

As in many other advanced economies, Hong Kong's population is ageing rapidly. Besides affecting the stock of labour supply, the literature also suggests that ageing could have a negative impact on the productivity growth of an economy. This article aims to quantify the impacts of population ageing on Hong Kong's productivity growth. By analysing advanced economies using a panel regression, it is crudely estimated that population ageing would lower total factor productivity (TFP) growth in Hong Kong, and hence economic growth, by around 0.1 percentage point per annum during 2025-2044. The results suggest that the main channel through which ageing will affect Hong Kong's economic growth will be through dwindling labour supply.

人口高齡化對香港生產力增長的影響

摘要

一如很多其他先進經濟體，香港的人口正在急速高齡化。除了影響勞工供應外，文獻亦指出人口高齡化可能會對經濟體的生產力增長有負面影響。本文旨在量化人口高齡化對香港生產力增長的影響。透過對先進經濟體進行縱橫資料迴歸分析，粗略估計人口高齡化會降低香港在 2025 至 2044 年期間平均每年全要素生產率增長率以至經濟增長率約 0.1 個百分點。結果顯示人口高齡化對香港經濟增長的影響主要來自勞工供應減少。

The views and analysis expressed in this article are those of the authors and do not necessarily represent the views of the Office of the Government Economist.

I. INTRODUCTION

1. As in many other advanced economies, Hong Kong's population is ageing rapidly (see Wong and Yeung, 2019¹ for a detailed review). While it is widely accepted that ageing will negatively affect potential economic growth through dwindling labour supply (Brown and Guttman, 2017)², the literature also suggests that ageing could have a negative impact on productivity growth if it is not accompanied by mitigating responses³. This letter briefly reviews the possible relationship between ageing and productivity and attempts to quantify the extent to which ageing will affect productivity (and hence economic) growth in Hong Kong.

2. The structure of this letter is as follows. **Part II** reviews the relevant literature on the relationship between population ageing and productivity growth. **Part III** describes the data and methodology used. **Part IV** analyses the results. **Part V** compares the impact of ageing on Hong Kong's economic growth through the productivity and labour supply channels. **Part VI** concludes.

II. LITERATURE REVIEW

3. A standard measure of an economy's productivity is total factor productivity (TFP). In terms of a production function, TFP is the residual of economic growth that cannot be explained by factor accumulation. Then, from a theoretical perspective, there are three possible channels through which population ageing could affect TFP.

4. First, productivity may vary with age. Younger workers may on average have better education but less work experience. On the other hand, while older workers tend to have more work experience, they may also have less creative ability and suffer from deteriorating health, obsolescence of skills, etc. Hence, it is possible that individual worker productivity varies with age in an inverted U-shape pattern. As the society ages and the share of older workers rises, this might put downward pressure on overall productivity growth. Empirical research generally points to a decline in productivity after passing through a certain age threshold, though estimates of the peak age vary. For example, using a panel of Portuguese firms from both manufacturing and services

¹ Wong, K., and Yeung, M. (2019). Population ageing trend in Hong Kong. *Office of the Government Economist Economic Letter 2019/02*. <https://www.hkeconomy.gov.hk/en/pdf/el/el-2019-02.pdf>

² Brown, A., and Guttman, R. (2017). Ageing and labour supply in advanced economies. *Reserve Bank of Australia Bulletin, December 2017*. <https://ho.website.rba.gov.au/publications/bulletin/2017/dec/pdf/bu-1217-5-ageing-and-labour-supply-in-advanced-economies.pdf>

³ For instance, firms could increase their investment on technology to raise their productivity while the Government can also act to create a conducive environment to innovation. See paragraph 20 for further discussion.

sectors, Cardoso et al. (2011)⁴ showed that productivity displays an inverted U-shaped pattern with the share of workers at different ages, reaching a plateau between 50-59 before falling slightly at 60-65⁵. Hellerstein et al. (1996)⁶ used US manufacturing sector data and estimated that workers aged 55 and above are less productive than younger workers.

5. Second, population ageing may cause the propensity to produce and adopt innovations or technological breakthroughs to decline. For example, Jones (2005)⁷ revealed that the age distribution of Nobel Prize winners and great inventors follows a hump shape, with a peak at around 40. Similarly, the age distribution of an economy may also be a factor that affects idea adoption as a whole as younger workers may be more adaptive to new technology.

6. Third, ageing might induce a change in relative demand for output from different sectors, which would in turn lead to a structural transformation of the economy (Siliverstovs et al., 2011)⁸. For example, a rising number of elders would increase the demand for health care services. To the extent that different sectors have different levels of productivity, this relative change could cause a change in the overall productivity level of an economy.

7. With these factors in mind, empirical studies also suggest that ageing and the ensuing changes in age structure could have some negative effects on TFP growth, though these studies do not further analyse the relative strength of the aforementioned possible channels. For example, Adler et al. (2017)⁹ used a panel dataset comprised of both advanced and emerging economies from 1985 to 2014 to estimate that changes in age structure lowered TFP growth by 0.2 to 0.5 percentage point per year in advanced economies and by around 0.1 percentage point per year in emerging economies. Aiyar

⁴ Cardoso, A., Guimaraes, P., and Varejão, J. (2011). Are older workers worthy of their pay? An empirical investigation of age-productivity and age-wage nexuses. *De Economist*, 159(2), 95-111.

⁵ Cardoso et al. (2011) did not include workers aged over 65 in their regression.

⁶ Hellerstein, J., Neumark, D., and Troske, K. (1996). Wages, productivity, and worker characteristics: Evidence from plant-level production functions and wage equations. *NBER Working Paper 5626*. https://www.nber.org/system/files/working_papers/w5626/w5626.pdf

⁷ Jones, B. (2005). Age and great invention. *NBER Working Paper 11359*. https://www.nber.org/system/files/working_papers/w11359/w11359.pdf

⁸ Siliverstovs, B., Kholodilin, K., and Thiessen, U. (2011). Does aging influence structural change? Evidence from panel data. *Economic Systems*, 35(2), 244-260.

⁹ Adler, G., Duval, R., Furceri, D., Çelik, S., Koloskova, K., and Poplawski-Ribeiro, M. (2017). Gone with the headwinds: Global productivity. *IMF Staff Discussion Note SDN/17/04*. <https://www.imfconnect.org/content/dam/imf/Spring-Annual%20Meetings/SM17/Documents%20and%20Publications/sdn1704.pdf>

et al. (2016)¹⁰ estimated that ageing workforces reduced TFP growth of European economies by around 0.1 percentage point per year during 1984 to 2007 and projected that they will reduce TFP growth by around 0.2 percentage point annually during 2014 to 2035. Liu and Westelius (2016)¹¹ used a panel of Japanese prefectures to estimate that shifts in the age distribution reduced Japan's annual TFP growth by around 0.7 to 0.9 percentage point between 1990 and 2005.

8. Some earlier studies also reported negative effects of ageing on productivity growth in Hong Kong. For example, by proxying ageing using the share of the workforce aged 55-64 and the dependency ratio, an IMF study in 2017¹², using a panel of Asian and European economies, estimated that the TFP growth loss in Hong Kong due to ageing of the working population would be rather small, at less than 0.1 percentage point per year, during 2021 to 2030. Park and Shin (2011)¹³, using a panel of Asian economies and the dependency ratio as a measure of population ageing, estimated that the loss in Hong Kong's TFP growth during 2021 to 2030 would be around 0.1 percentage point per year.

III. DATA AND METHODOLOGY

9. Earlier studies related to Hong Kong generally used dependency ratios to proxy for ageing, which may not fully capture the effects of ageing on the labour force because dependency ratios and the age distribution of the labour force are two different concepts. To study the possible effects of population ageing with a more finely calibrated approach, similar to that used by Feyrer (2008)¹⁴, a panel regression analysis is conducted with selected age shares as explanatory variables so as to better capture the change in age structure in the workforce. An advantage of using the panel regression approach instead of simply using Hong Kong data alone is that we are able to control for the unobserved time varying factors like a declining cost in adopting

¹⁰ Aiyar, S., Ebeke, C., and Shao, X. (2016). The impact of workforce aging on European productivity. *IMF Working Paper WP/16/238*. <https://www.imf.org/~media/Websites/IMF/imported-full-text-pdf/external/pubs/ft/wp/2016/wp16238.ashx>

¹¹ Liu, Y., and Westelius, N. (2016). The impact of demographics on productivity and inflation in Japan. *IMF Working Paper WP/16/237*. <https://www.imf.org/~media/Websites/IMF/imported-full-text-pdf/external/pubs/ft/wp/2016/wp16237.ashx>

¹² Salgado, R. (2017). 2. Asia: At risk of growing old before becoming rich? In *Regional Economic Outlook, April 2017, Asia and Pacific: Preparing for Choppy Seas*. IMF. <https://www.elibrary.imf.org/view/IMF086/24034-9781475575064/24034-9781475575064/ch02.xml>

¹³ Park, D., and Shin, K. (2011). Impact of population aging on Asia's future growth. *ADB Economics Working Paper Series No. 281*. <https://www.adb.org/publications/impact-population-aging-asias-future-growth>

¹⁴ Feyrer, J. (2008). Aggregate evidence on the link between age structure and productivity. *Population and Development Review*, 34, 78-99.

technology that correlates with the ageing trend. Moreover, there would also be more observations to allow for more precise estimation.

10. The data on TFP are sourced from Penn World Table version 10.0. Labour force statistics are sourced from the International Labor Organization’s online database, while demographic statistics are sourced from the World Bank. The data cover 25 advanced economies including Hong Kong¹⁵ spanning from 1983 to 2019.

11. In the baseline specification, the labour force is divided into six age groups (15-24, 25-34, 35-44, 45-54, 55-64 and 65-and-above). The logarithm of TFP is then regressed on the share of these groups in the labour force. A full set of economy and time dummy variables (D_i and D_t) is added to control for economy-specific and time-specific fixed effects. To avoid perfect multi-collinearity, the share of the labour force aged 45-54 is dropped from the regression. The regression is estimated in first differences for robustness to any potential unit root problem.

$$\Delta \ln(TFP_{it}) = \beta_0 + \beta_1 \Delta S_{15-24,it} + \beta_2 \Delta S_{25-34,it} + \beta_3 \Delta S_{35-44,it} + \beta_4 \Delta S_{55-64,it} + \beta_5 \Delta S_{65+,it} + D_i + D_t + u_{it} \quad (1)$$

12. Besides the above baseline regression, we also tried alternative specifications by using the elderly dependency ratio and child dependency ratio, which are also commonly used in the literature. However, conceptually, dependency ratios measure the size of the population who are likely to be socially and/or economically dependent in relation to the working age population who theoretically provide social and economic support (Census and Statistics Department, 2018)¹⁶. Hence, they represent the ageing trend more from the perspective of the available working population (i.e. labour supply) to provide old-age and child support than from the age structure of the workforce itself. In principle, after controlling for the age structure of the labour force, these ratios should not be significantly related to TFP.

IV. RESULTS

13. The baseline regression results are shown in column (1) of **Table 1**. As we have dropped the share of the labour force aged 45-54 from the regression, the coefficients represent the impact on TFP growth when there is a shift from the share of the labour

¹⁵ The definition follows that adopted by the IMF World Economic Outlook. San Marino, Cyprus, Estonia, Korea, Latvia, Lithuania, Malta, Slovak Republic, Slovenia, Czech, Iceland, Macao, Puerto Rico and New Zealand are excluded owing to data limitations.

¹⁶ Census and Statistics Department, HKSARG. (2018). Dependency trend in Hong Kong. *Hong Kong Monthly Digest of Statistics November 2018*. <https://www.statistics.gov.hk/pub/B71811FA2018XXXXB0100.pdf>

force aged 45-54 to these age groups. For instance, the coefficient for the share of the labour force aged 65-and-above is significantly negative (-0.828), and a 1 percentage point increase in the share of labour force aged 65-and-above accompanied by a 1 percentage point decrease in the share of labour force aged 45-54 will translate into a reduction in TFP growth of around 0.8 percentage point. The coefficients for 15-24, 25-34 and 35-44 are not statistically significant while that for 55-64 is significantly positive (albeit at the 10% level only), roughly consistent with an inverted U-shaped pattern of the impact of the age structure of the labour force on TFP.

Table 1: Regression results for TFP

	$\Delta \ln(A)$	$\Delta \ln(A)$	$\Delta \ln(A)$	$\Delta \ln(A)$	$\Delta \ln(A)$
	(1)	(2)	(3)	(4)	(5)
Δs_{15-24}	0.066	0.056	0.064	0.059	-
Δs_{25-34}	0.052	0.048	0.058	0.056	-
Δs_{35-44}	-0.104	-0.092	-0.084	-0.078	-
Δs_{55-64}	0.318*	0.313*	0.266*	0.267*	-
Δs_{65+}	-0.828***	-0.824***	-0.765***	-0.767***	-
$\Delta \ln(\text{Young age dependency ratio})$	-	-0.028	-	-0.015	-0.029
$\Delta \ln(\text{Old age dependency ratio})$	-	-	-0.070	-0.066	-0.111*
R^2	0.31	0.31	0.31	0.31	0.31
No. of observations	900	900	900	900	900

Notes: Standard errors are robust and clustered by economy.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

14. Columns (2) to (4) of *Table 1* report the results when dependency ratios are included. The coefficients for the dependency ratios are all insignificant at conventional levels, as hypothesised in paragraph 12. The baseline results are quite robust to these additions notwithstanding a slightly less negative estimated coefficient for the share of labour force aged 65-and-above. By way of comparison, column (5) shows the results when only the two dependency ratios are included. While the young age dependency ratio remains insignificant, the old age dependency ratio is marginally significant at 10% level, conceivably because the old-age dependency ratio is positively correlated with the share of elderly workers¹⁷, thereby picking up some of the effect of the former. This also suggests that a specification that explicitly incorporates the age structure of the labour force may present a more comprehensive picture than relying on dependency ratios alone.

¹⁷ The correlation coefficient is 0.24 in our dataset.

15. To give a better picture of the magnitude of the impact from the changing age structure of the labour force on productivity, we estimate the impact on Hong Kong's TFP growth with the baseline regression above, using both historical data and the latest 2019-based labour force projections for the period of 2025-2069 published by the Census and Statistics Department (C&SD). The results are summarised in **Table 2**. During 2015-2019, the labour force in Hong Kong showed a clear ageing trend, as evidenced by the increase in the share of the labour force aged 55-64 and 65-and-above by 3.2 percentage points and 1.7 percentage points respectively. Against this backdrop, the above regression estimates suggest that changes in the age structure of the labour force lowered Hong Kong's TFP growth by 0.1 percentage point per year on average during this period.

16. Looking ahead, the ageing of Hong Kong's labour force will continue, with the share of workers aged 65-and-above projected to rise by 1.7 percentage points during 2025-2044. The change in the age structure of the labour force is roughly estimated to drag down Hong Kong's TFP growth by around 0.1 percentage point per year on average, largely similar to other estimates in the literature as described in paragraph 8. Beyond 2044, given the positive effect of the share of the labour force aged 55-64, the pick-up in this share¹⁸ would somewhat offset the drag from the faster increase in the share of the elderly labour force, resulting in a largely neutral effect on TFP growth.

Table 2: Estimates of the impact of changing age structure of labour force on TFP growth

	Cumulative change in the share of labour force in specific age group (% pt)						Estimated impact on TFP growth (% pt p.a.)
	15-24	25-34	35-44	44-54	55-64	65+	(1)
2015-2019	-1.2	-1.7	0.4	-2.3	3.2	1.7	-0.1
2025-2044	0.1	-0.1	-2.3	1.2	-0.6	1.7	-0.1
2045-2069	*	-4.1	-0.9	-0.9	3.3	2.5	*
2025-2069	0.1	-4.2	-3.2	0.3	2.8	4.2	-0.1

Note: (*) Change less than $\pm 0.05\%$ pt.

¹⁸ The movement in the share of the labour force aged 55-64 largely mirrors the movement in the share of the population aged 55-64, which fell from 15.5% in 2024 to 13.0% in 2044 before rising back somewhat to 13.9% in 2069. The mild rebound of the latter is conceivably attributable in part to the short-term birth rebound during 2006-2013 amid the surge in the number of Type II babies, as these babies will gradually enter ages 55-64 toward the end of the projection period.

V. COMPARING THE SIZE OF THE LABOUR SUPPLY AND PRODUCTIVITY CHANNELS

17. As TFP growth will have a one-to-one impact on overall per-capita economic growth, the crude estimates presented above also represent the drag that population ageing will pose on Hong Kong's economic growth through the productivity channel. By way of comparison, we also estimate the impact of ageing on economic growth through changes to the labour supply over the coming decades, so as to shed some light on their relative magnitude. Specifically, noting that per capita output (Y/P) can be written as the product of the labour-to-population ratio (L/P) and labour productivity (Y/L)¹⁹, we further rewrite the labour-to-population ratio in the following form

$$\frac{Y}{P} = \frac{L}{P} \times \frac{Y}{L} = \left[\frac{P_{15+}}{P} \times \frac{LBNP_{15+}}{P_{15+}} \times LFPR \right] \times \frac{Y}{L} \quad (2)$$

where P_{15+} refers to the population aged 15 and above, $LBNP_{15+}$ refers to the land-based non-institutional population aged 15 and above, and $LFPR$ refers to the labour force participation rate. Taking the logarithm and first difference on the labour-to-population ratio yields

$$\Delta \ln \left(\frac{L}{P} \right)_t \approx \Delta \ln \left(\frac{P_{15+}}{P} \right)_t + \Delta \ln \left(\frac{LBNP_{15+}}{P_{15+}} \right)_t + \frac{\Delta(LFPR_t)}{LFPR_{t-1}}, \quad (3)$$

where the last term comes from the standard approximation formula for the first difference of the logarithm. The change in LFPR in the last term can be further broken down by age group²⁰, denoted by subscript k , using a standard shift-share decomposition formula

$$\begin{aligned} \Delta \ln \left(\frac{L}{P} \right)_t &\approx \Delta \ln \left(\frac{P_{15+}}{P} \right)_t + \Delta \ln \left(\frac{LBNP_{15+}}{P_{15+}} \right)_t \\ &+ \frac{1}{LFPR_{t-1}} \sum_k \overline{S_{k,t}} \Delta LFPR_{k,t} + \frac{1}{LFPR_{t-1}} \sum_k \overline{LFPR_{k,t}} \Delta S_{k,t}. \end{aligned} \quad (4)$$

The first two terms and last term then capture the effects of the changing age structure on the labour-to-population ratio. The reason why the second term is also related to population ageing is because a major reason for the difference between the land-based non-institutional population and the whole population is mainly the hospitalised population and persons living in care homes, of whom a large proportion are the elderly. Hence, population ageing will tend to lower this ratio. The impact of a change in the labour-to-population ratio will then be passed on one-to-one to per-capita economic growth.

¹⁹ TFP growth will have a one-to-one impact on the labour productivity term.

²⁰ The age groups used in the decomposition are 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64, 65-69, 70-74 and 75+.

18. The decomposition formula is then applied to the latest population and labour force projections published by C&SD to estimate the impact of population ageing. The results are shown in **Table 3**. The estimates in the second column suggest that ageing, as represented by the relevant terms in the decomposition formula, would drag down the labour-to-population ratio, and hence per-capita economic growth by around 0.5 percentage point per annum during 2025-2069, with most of the effect being seen in the first period (-0.7 percentage point per annum during 2025-2044). This shows that while ageing will negatively affect economic growth in Hong Kong by lowering productivity growth, the main channel is still from the decline in labour supply.

Table 3: Decomposition of the labour-to-population ratio

	Labour-to-population ratio (% p.a.)	<i>Of which due to:</i> <i>Ageing factor</i> (%pt p.a.)	<i>Other factors</i> (%pt p.a.)
	(1)	(2)	(3)
2025-2044	-0.5	-0.7	+0.2
2045-2069	-0.2	-0.3	+0.1
2025-2069	-0.3	-0.5	+0.2

VI. CONCLUDING REMARKS

19. This note discusses three possible channels through which population ageing could affect productivity growth: (i) individual worker productivity could vary with age; (ii) the age structure of the work force could affect innovation or idea adoption; and (iii) the age structure could affect the relative demand for various sectors. Using a panel of advanced economies, the empirical estimates show a negative relationship between the share of the elderly labour force and TFP growth. Applied to Hong Kong, it is roughly estimated that the changing age structure of the labour force will lower TFP growth, and hence economic growth, by around 0.1 percentage point per annum during 2025-2044. When compared to the estimated drag of 0.7 percentage point through the labour supply channel, this implies that the main channel by which ageing will affect Hong Kong's economic growth will still be the dwindling labour supply.

20. Yet, due caution should be exercised when interpreting the above estimation results. In particular, they are only based on historical relationship between productivity and population ageing that does not take into account the behavioural responses by the economy and the Government going forward. In fact, the Government is well aware of the challenges from population ageing and adopted a multi-pronged

strategy to tackle them. Among others, the Government is striving to create an environment conducive to innovation and technology development, which is a key source of productivity growth. For instance, an enhanced tax deduction for qualifying R&D expenditure incurred by enterprises on or after April 2018 was introduced to encourage R&D activities. The Government is also enhancing Hong Kong's research infrastructure and capacity through the development of the Hong Kong-Shenzhen Innovation and Technology Park. As for the private sector, the literature has shown that firms could also actively invest in labour-saving technology in the face of dwindling labour supply, which would in turn help drive up the productivity (Acemoglu and Restrepo, 2017²¹). These dynamic mitigating responses could help create an effective cushion to the drag on productivity from population ageing.

²¹ Acemoglu, D., and Restrepo, P. (2017). Secular stagnation? The effect of aging on economic growth in the age of automation. *American Economic Review: Papers and Proceedings*, 107(5), 174-179. <https://pubs.aeaweb.org/doi/pdfplus/10.1257/aer.p20171101>