



## ***PRODUCTIVITY GROWTH IN HONG KONG: SECTORAL PATTERNS AND DRIVERS***

### ***Key points:***

- *Hong Kong's real GDP and real output per worker (a measure of labour productivity) have increased at a moderated pace in recent years compared with the period before the Global Financial Crisis (GFC). Our analysis suggests that the important factor for such a slowdown after the GFC appeared to be slower total factor productivity (TFP) growth, rather than physical or human capital accumulations. In particular, our estimates of TFP growth in Hong Kong during 2000–2013 reveal that the average annual overall TFP growth was remarkably high at 4.0% before 2009. But after 2009, it receded to an average annual growth rate of 2.6%.*
- *A breakdown of overall TFP growth in terms of contribution by key business sectors shows that the major contributor to this overall TFP growth moderation was the import/export (I/E) trade sector. After the GFC, contribution by the I/E trade sector has declined notably while that by the wholesale, retail, restaurant and hotel sector increased. In the financial sector, banks' contribution remained fairly stable and resilient throughout 2000–2013, while the non-bank financial corporations' contribution was relatively volatile. Such a TFP growth pattern reflects a number of underlying drivers.*
- *Conceptually, TFP hinges on a host of supply-side factors that capture productivity benefits from various sources. These include (1) technology advancement and efficiency gains, (2) product and service innovation, and (3) trade liberalisation and reform measures. Our analyses of the possible underlying drivers of TFP developments in these key business sectors suggests that much of the TFP growth in Hong Kong in the past has been driven by trade and financial liberalisation in Mainland China.*
- *Going forward, given continued financial reforms in Mainland China, the financial sector is likely to remain a major driver behind Hong Kong's overall TFP growth. These reforms would continue to support TFP growth in the financial sector through efficiency gains and innovation. The I/E trade sector would likely continue to*

*contribute to overall TFP growth, but could be restrained by the slow-growing international trade flows amid weak global growth and import absorption from the advanced economies. Finally, the tourism-related sector's contribution to TFP growth is expected to weaken after traversing a high-growth stage.*

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The views and analysis expressed in this paper are those of the authors, and do not necessarily represent the views of the Hong Kong Monetary Authority.

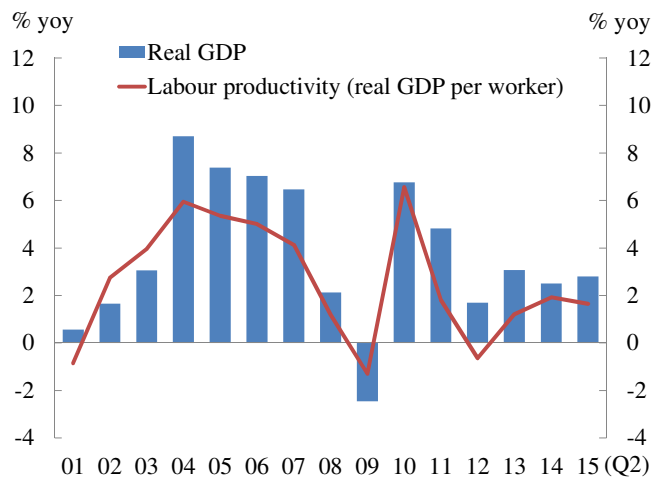
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## I. INTRODUCTION

After staging a strong and swift recovery from the global financial crisis (GFC) in 2009–2011, the Hong Kong economy has been growing moderately for some time, progressing at around 2–3% a year since 2012 (Chart 1). This was in sharp contrast with the pre-GFC period when the economy grew at about 5% a year on average. Similarly, real output per worker — a measure of labour productivity — has also increased at a gentler annual pace of 0.8% in recent years, compared with an average of 3.6% before the GFC. This raises the question of whether the recent moderate growth path has become a new normal. This paper analyses the factors behind slower trend growth in Hong Kong, and in particular, the total factor productivity (TFP) growth of selected major business sectors in Hong Kong for the period since 2000. This may shed light on the medium-term prospects of the major business sectors and potential growth of the Hong Kong economy.

**Chart 1: Growth in real GDP and output per worker**



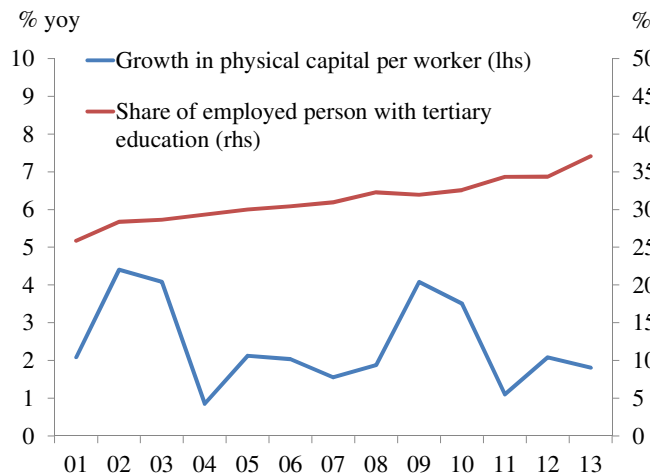
Sources: Census and Statistics Department (C&SD) and Hong Kong Monetary Authority (HKMA) staff estimates.

The rest of the paper is organised as follows. Section II argues that the key reason behind slower growth in real output per worker after the GFC appeared to be the moderation in TFP growth. An estimate of TFP growth during 2000–2013 and a breakdown of overall TFP growth by key business sectors are presented. Section III then examines the underlying drivers of sectoral TFP. The final section concludes and briefly discusses the TFP outlook for some key business sectors.

## II. ECONOMIC GROWTH AND TOTAL FACTOR PRODUCTIVITY

Growth in real output per worker depends on physical and human capital accumulations as well as TFP growth. A cursory look at the data suggests that physical and human capital accumulations in Hong Kong have progressed steadily and they cannot explain the growth slowdown of real output per worker in the post-GFC period. For example, physical capital per worker has continued to increase moderately at an average annual rate of around 2% between 2001 and 2013 (Chart 2), while the sharp increase after the dotcom bubble burst and the GFC appeared to be transitory, mainly reflecting firms' tendency to hold back hiring of workers during recessions. Moreover, worker skills seemed to have continued to pick up, as the overall share of higher educated workers (with educational attainment at the tertiary level or above) rose to 37.1% in 2013 from 30.4% in 2006 and 25.9% in 2001.

**Chart 2: Indicators of physical and human capital accumulations**



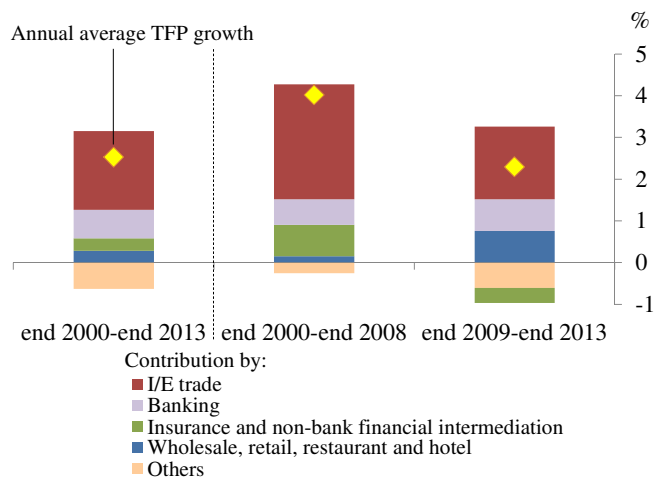
Note: The perpetual inventory method is used to construct capital stock.  
Sources: C&SD and HKMA staff estimates.

Rather, the important factor for growth slowdown of real output per worker after the GFC appeared to be slower TFP growth, which is the portion of output increases not directly produced by measured inputs. Chart 3 provides an estimate of TFP growth in Hong Kong during 2000–2013 and a breakdown of overall TFP growth in terms of contribution by key business sectors. It is derived based on the estimated TFP of key business sectors using the method of Data Envelopment Analysis.<sup>1</sup> (For details on the estimation method and data sources, please refer to Annex A.) This measure of overall TFP grew by an average 2.7% a

<sup>1</sup> Because of data availability, this study only considers some selected key business sectors, which together account for over 90% of GDP in Hong Kong.

year for the whole period of 2000–2013. Using 2009 as a watershed, the average annual TFP growth was remarkably high at 4.0% before 2009. But after 2009, it receded to an average annual growth rate of 2.6%. The major contributor to overall TFP growth moderation was the import/export (I/E) trade sector. After the GFC, contribution by the I/E trade sector has declined notably while that by the wholesale, retail, restaurant and hotel sector increased.<sup>2</sup> In the financial sector, banks' contribution remained fairly stable and resilient throughout 2000–2013, while the non-bank financial corporations' contribution was relatively volatile.

**Chart 3: Total factor productivity growth and contribution by major economic sectors**



Source: HKMA staff estimates.

### III. DRIVERS OF SECTORAL TOTAL FACTOR PRODUCTIVITY

But what are the reasons behind the change in the TFP growth pattern in Hong Kong during 2000–2013? Conceptually, TFP hinges on a host of supply-side factors that capture productivity benefits from various sources. These include (1) technology advancement and efficiency gains, (2) product and service innovation, and (3) trade liberalisation and reform measures. The following is an analysis on the possible underlying drivers of TFP developments in the key business sectors.

<sup>2</sup> Ideally, the tourism sector should be a focus of the study but no reliable data are available for estimation of TFP growth, so the broader wholesale, retail, restaurant and hotel sector is considered.

**Table 1: TFP growth of major economic sectors**

	TFP growth (%)		
	2000-2008	2009-2013	2000-2013
<b>Overall</b>	<b>4.0</b>	<b>2.6</b>	<b>2.7</b>
<i>of which:</i>			
<b>I/E trade</b>	<b>9.3</b>	<b>6.1</b>	<b>6.6</b>
<b>Financial</b>	<b>6.3</b>	<b>1.3</b>	<b>4.2</b>
Banking	5.1	5.0	5.2
Non-bank financial	11.6	-7.1	3.7
<b>Wholesale, retail, restaurant &amp; hotel</b>	<b>1.4</b>	<b>7.1</b>	<b>2.5</b>
Wholesale & retail	2.8	9.1	4.4
Restaurant & hotel	0.1	2.6	0.1

Note: Compound annual growth rates are used. In this table, the TFP growth rates of the financial sector and the wholesale, retail, restaurant and hotel sector are estimated by first grouping the inputs and outputs in their subsectors. The insurance sector is not shown here as its contribution to overall TFP growth is small.

Source: HKMA staff estimates.

### a) The I/E trade sector

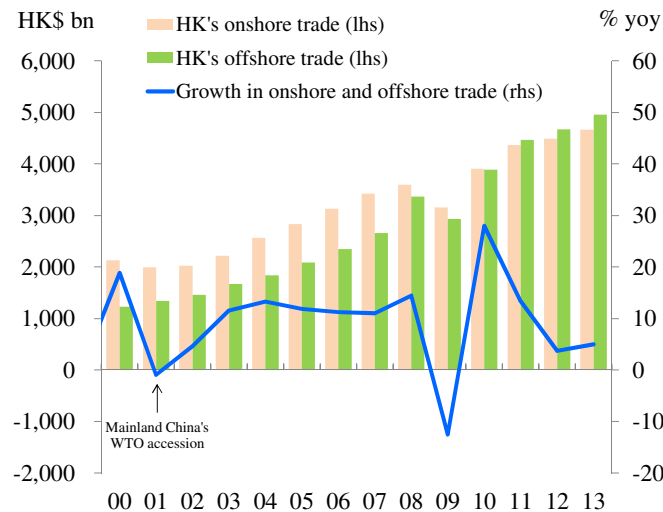
Among all the selected sectors, the I/E trade sector recorded the fastest annual TFP growth of 6.6% during 2000–2013 (Table 1). Indeed, this sector’s TFP growth was extraordinarily fast before the GFC, at an annual average of 9.3%. This overall fast TFP growth was boosted by trade liberalisation in Mainland China (including its accession to the World Trade Organisation in 2001), which in turn led to relatively brisk growth in Hong Kong’s onshore and offshore trade (Chart 4). In particular, the fast TFP growth was driven by efficiency gains from the continued expansion of Hong Kong’s manufacturing base to Mainland China and other lower cost areas and the rise of offshore trade business, as well as product and service innovation as traders climbed up the global value chain.<sup>3</sup>

After the GFC, the I/E trade sector’s TFP growth has moderated to an annual average of 6.1%, but still high compared with other business sectors. The TFP moderation was probably attributable to the longer-term impact of the GFC, which has taken a toll on world output growth and international trade flows. It

<sup>3</sup> The climbing-up of the global value chain included provision of more value-added services such as sourcing, design, production and its management, compliance of quality standards and logistics arrangement, etc. For further details, see Leung, Chow, Szeto and Tam (2008).

could be difficult for traders in Hong Kong to reallocate efficiently their productive resources that once geared towards the advanced economies to production for final demand of other higher growth emerging markets. Continued weakness in the advanced economies would put at least some of the productive resources (such as machinery and skilled labour) idle and would not be conducive to the progress and evolution of technological innovation for the production process.

**Chart 4: Onshore and offshore trade value of Hong Kong**



Note: Onshore trade is the sum of merchandise exports and retained imports. For the period before 2002, official offshore trade data are not available, and figures in the chart are imputed based on margins and commissions earned.

Sources: C&SD and HKMA staff estimates.

## b) The financial sector

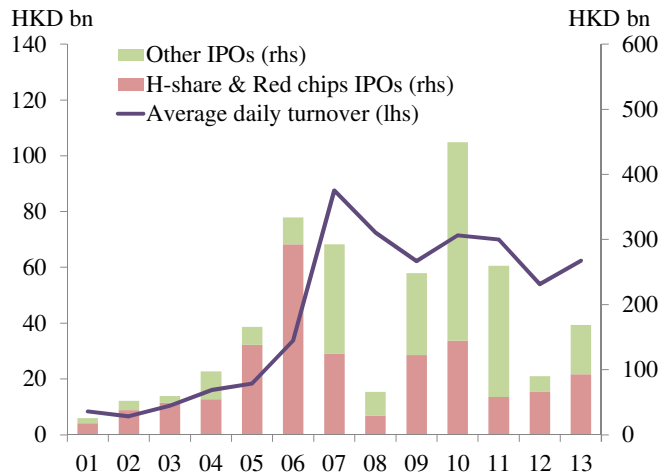
The financial sector as a whole was also a key growth spot, recording above-average TFP growth of 4.2% between 2000 and 2013 (Table 1). This sector's TFP growth was markedly higher before the GFC but declined afterwards due to volatile TFP performance of the non-bank financial sector, although the TFP growth of the banking sector remained resilient.

The TFP growth of the non-bank financial sector<sup>4</sup> surged in the pre-GFC period amid booming H-share fund-raising activities and robust equity market trading (Chart 5). The underlying TFP growth driver included the Mainland financial market reforms that facilitated the listing of Mainland enterprises in Hong Kong. There was also product innovation with the taking-off of the derivatives and exchange-traded funds (ETFs) markets. However, this

<sup>4</sup> It includes stock brokerage, asset management, finance leasing, and investment and holding companies.

sector experienced a period of TFP decline after the GFC, as stock market turnover tapered off from a high level and the H-share fundraising activities also levelled off. Taking both the financial upcycle and downcycle as a whole during the period of 2000–2013, the non-bank financial sector recorded TFP growth of about 3.7%, still higher than the 2.7% overall TFP growth of the whole economy.

**Chart 5: IPOs and stock market turnover on Main Board and Growth Enterprise Market**



Source: Hong Kong Exchanges and Clearing Limited.

The banking sector’s TFP growth has remained resilient, at around 5% a year in both the pre and post-GFC periods. Similar to the non-bank financial sector, financial reforms in Mainland China that bolstered H-share IPOs and equity market trading have helped raise this sector’s TFP growth in the pre-GFC period. Banks have diversified their sources of income and secured fast growth in business, as evidenced by the sharp rise in the share of non-interest income from around 36% in 2000 to 57% in 2007.

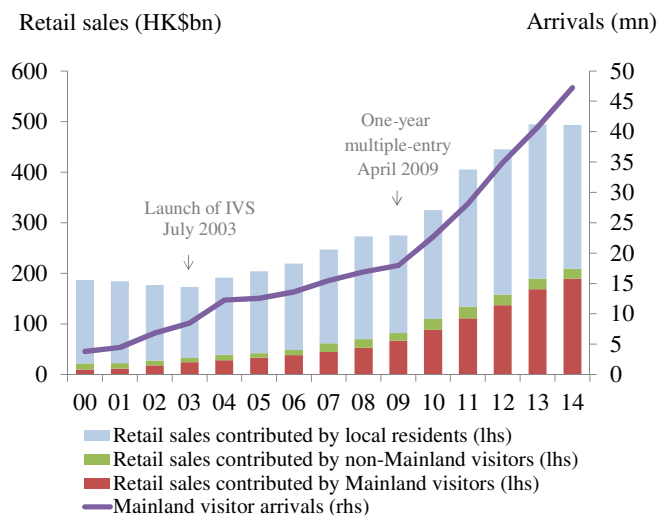
Meanwhile, the launch of RMB banking business in Hong Kong since 2004 and the banking liberalisation measures under the Mainland and Hong Kong Closer Economic Partnership Arrangement (CEPA) have opened up new business opportunities and stimulated development of new financial products and services (including Mainland-related lending, and RMB deposits, loans, trade settlements and dim sum bonds), thereby supporting TFP growth. Throughout the period of 2000–2013, the banking sector also raised their efficiency by outsourcing and/or relocating labour intensive processes (e.g. data processing) to low-cost areas, and promoting electronic and internet banking.



### c) The wholesale, retail, restaurant and hotel sector

The TFP growth of the wholesale, retail, restaurant and hotel sector was relatively low in the pre-GFC period particularly before 2003, but it has picked up considerably afterwards (Table 1). The main driver behind the acceleration of TFP growth was the launch of the Individual Visit Scheme (IVS) in 2003, its progressive extension in later years, and particularly the introduction of the one-year multiple-entry endorsements in 2009 for eligible Shenzhen residents (until the one-trip-one-week cap took effect from mid-April 2015).<sup>5</sup> The enhanced ease of travel brought by IVS, together with other positive factors such as the increasing affluence of Mainland residents and the RMB appreciation, led to a phenomenal increase in Mainland visitor arrivals and solid business growth of the local wholesale, retail, restaurant and hotel sector (Chart 6).

**Chart 6: Mainland’s visitor arrivals and their share in terms of retail sales value**



Note: Retail sales contributed by tourists refer to the shopping expenses of overnight and same-day visitors. Because of data availability, only the shopping expenses of overnight visitors were covered for the period before 2007.

Sources: C&SD, Hong Kong Tourism Board and HKMA staff estimates.

<sup>5</sup> The IVS was first implemented in four Guangdong cities and later expanded several times to cover more cities and municipalities. It allows eligible Mainland residents to visit Hong Kong in their individual capacity, whereas in the past, they could only travel to Hong Kong under business visas or by joining organised group tours.

#### **IV. OUTLOOK FOR PRODUCTIVITY GROWTH AND CONCLUSION**

Our analysis shows that the I/E trade and financial sectors have provided the major support to Hong Kong's overall TFP growth during 2000–2013, with extra boost from the wholesale, retail, restaurant and hotel sector over the past few years. But the contribution of the I/E trade sector has somewhat weakened after the GFC. On the other hand, banks' TFP growth has remained highly resilient and lent a stable support to overall TFP growth of the economy. Going forward, the financial sector is likely to remain a major driver behind Hong Kong's overall TFP growth. Continued financial reforms in Mainland China would continue to support TFP growth in the financial sector through efficiency gains and innovation. While the I/E trade sector would likely continue to contribute to overall TFP growth, it could be restrained by the slow-growing international trade flows amid weak global growth and import absorption from the advanced economies. Meanwhile, the tourism-related sector's contribution to TFP growth is expected to weaken after traversing a high-growth stage.

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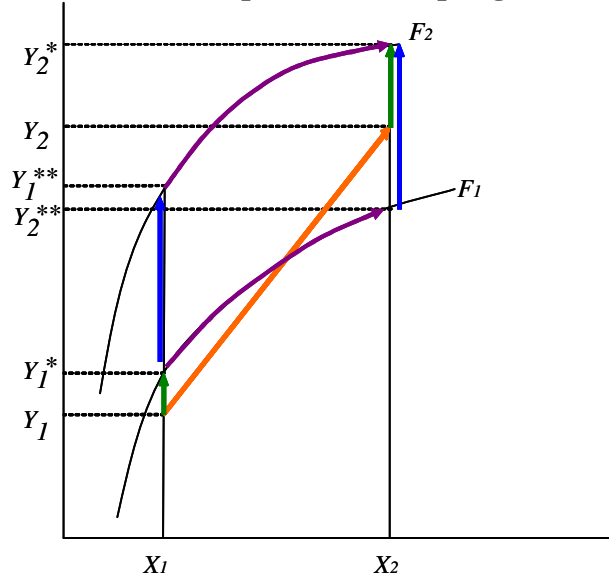
**ANNEX A: ESTIMATION OF TOTAL FACTOR PRODUCTIVITY GROWTH AND DATA SOURCES**

In this paper, the Data Envelopment Analysis (DEA) method is adopted to measure the total factor productivity (TFP) growth of selected business sectors in Hong Kong. In what follows, we draw heavily from Leung, Han and Chow (2009), Coelli (1996) and Fare et al. (1994) and use a simple example to illustrate.

**a) Concepts and estimation**

Calculation of TFP growth and its components under the DEA method is illustrated in Chart A, where only one input is assumed for simplicity.

**Chart A: Decomposition of output growth**



Source: HKMA staff.

In Chart A, the actual input-output set is  $(X_1, Y_1)$  in period 1 and  $(X_2, Y_2)$  in period 2.  $F_1$  represents the output frontier in period 1 and  $F_2$  the frontier in period 2.  $Y_1^*$  is the potential output in period 1 given input of  $X_1$ , and  $Y_2^*$  the potential output in period 2 given input of  $X_2$ . The gross output growth (orange arrow in Chart A) can be defined in two ways, such that

$$\frac{Y_2}{Y_1} = \frac{(Y_1^*/Y_1)}{(Y_2^*/Y_2)} * \frac{Y_1^{**}}{Y_1^*} * \frac{Y_2^*}{Y_1^{**}} \quad (1)$$

or

$$\frac{Y_2}{Y_1} = \frac{(Y_1^*/Y_1)}{(Y_2^*/Y_2)} * \frac{Y_2^*}{Y_2^{**}} * \frac{Y_2^{**}}{Y_1^*} \quad (2)$$

The first term on the right hand side of equation (1) or (2) is called the technical efficiency change (TEC), where  $\frac{Y_1^*}{Y_1}$  and  $\frac{Y_2^*}{Y_2}$  (green arrows in Chart A) are the distance of the realised output from the potential output in period 1 and period 2 respectively. The second term  $\frac{Y_1^{**}}{Y_1^*}$  (denoted as  $TP^1$ ) on the right hand side of equation (1) or  $\frac{Y_2^*}{Y_2^{**}}$  (denoted as  $TP^2$ ) on the right hand side of equation (2), which measures the shift of production frontier with the same inputs (blue arrows in Chart A), is called technological progress (TP). Finally,  $\frac{Y_2^*}{Y_1^{**}}$  in equation (1) (denoted as  $dY_x^1$ ), or  $\frac{Y_2^{**}}{Y_1^*}$  in equation (2) (denoted as  $dY_x^2$ ) measures the change in potential output with respect to either one of the frontiers due to changes in inputs from  $X_1$  to  $X_2$  (purple arrows in Chart A).

Equations (1) and (2) can be rewritten as

$$\frac{Y_2}{Y_1} = TEC * TP^1 * dY_x^1 = TFP^1 * dY_x^1 \quad (1')$$

and

$$\frac{Y_2}{Y_1} = TEC * TP^2 * dY_x^2 = TFP^2 * dY_x^2 \quad (2')$$

Next defining the Malmquist TFP index  $M(Y_t, X_t, Y_{t-1}, X_{t-1})$  as a geometric average written as

$$M(Y_t, X_t, Y_{t-1}, X_{t-1}) = \left[ \frac{(Y_2/Y_2^{**})}{(Y_1/Y_1^*)} * \frac{(Y_2/Y_2^*)}{(Y_1/Y_1^{**})} \right]^{0.5} \quad (3)$$

By rearranging equation (3), it is easy to verify that

$$M(Y_t, X_t, Y_{t-1}, X_{t-1}) = (TFP^1 * TFP^2)^{0.5} \quad (4)$$

Equation (4) shows that the Malmquist TFP index is a simple geometric average of TFPs defined in gross output growth equations (1') and (2').

According to Coelli (1996), the four components of the Malmquist TFP index in

equation (3) can be estimated by solving a linear programming problem under the assumption of constant return to scale. In particular, we use the non-parametric linear programming technique to find the production frontier (potential output).

In addition, the Malmquist TFP index of the overall economy,  $Overall\ TFP_t$ , is calculated as a weighted average of the Malmquist TFP index of each business sector based on its percentage share of value added in the whole economy:<sup>6</sup>

$$Overall\ TFP_t = \prod_{i=1}^j \omega_{it} M(Y_{it}, X_{it}, Y_{it-1}, X_{it-1})$$

where  $M(Y_{it}, X_{it}, Y_{it-1}, X_{it-1})$  is the estimated Malmquist TFP index of the selected sector  $i$  in year  $t$ ,  $\omega_{it}$  is percentage share of value added in that sector to the overall economy in year  $t$ .

## b) Data

Annual sectoral survey data for 1985–2013 are employed to estimate the TFP growth. Ten service sectors are selected in our study and they together account for over 90% of GDP in Hong Kong (see Table A). Some data reconciliation and extrapolation are performed due to sector reclassification and breaks in series.

**Table A: The selected ten economic sectors**

1- Wholesale & retail trade	6- Finance (excluding banking)
2- Restaurants & hotels	7- Business services*
3- Trade	8- Insurance
4- Transport & storage	9- Construction & real estate
5- Communications and IT*	10- Banking

Note: \* These sectors have been reclassified from 2005 onwards.  
Source: C&SD.

<sup>6</sup> In the previous study of Leung, Han and Chow (2009), the overall TFP index was a simple geometric average of Malmquist TFP index of each business sector. We made an improvement in this study by introducing a set of weights for different sectors. This is arguably more appropriate and should better reflect the overall productivity performance.

For outputs in the production function, data come from the production-based GDP and the value added of the four key industries provided by the Census and Statistics Department (C&SD). As to factor inputs, the estimated capital stocks and the number of persons engaged data are used. The raw data are mainly obtained from the Annual Economic Survey and Key Statistics on Business Performance and Operating Characteristics conducted by the C&SD. The capital stock for the banking sector is obtained from the internal data of fixed asset items in the balance sheet of all Authorized Institutions, which are compiled by the Hong Kong Monetary Authority. For the remaining nine service sectors, the perpetual inventory method is used to construct the time series of capital stocks. More specifically, we first take the estimated total capital stock in 1985  $K_{1985}^r$  as given (extracted from Leung, Han and Chow (2009)). The initial capital stock (i.e. capital stock in 1985) for each service sector  $K_{i1985}$  is then estimated by the following formula:

$$K_{i1985} = K_{1985}^r * \frac{\sum_{t=1986}^{1990} I_{it}}{\sum_{t=1986}^{1990} I_t}, \quad i = 1, 2, \dots, 9$$

where  $I_t$  is gross domestic capital formation in the private sector in year  $t$ ,  $I_{it}$  is gross additions to fixed assets in sector  $i$  in year  $t$ , both are obtained from the C&SD. After deriving  $K_{i1985}$ , the capital stocks for each service sector  $K_{it}$  can be calculated using the perpetual inventory equation:

$$K_{it} = I_{it} + (1 - d) * K_{it-1}, \quad d = 0.05, \quad t > 1985$$

where  $d$  is the depreciation rate which is assume to be 5%.

The value added data are converted into 2013 prices using the implicit deflator in the production-based GDP, and the nominal gross additions to fixed assets are also converted into 2013 prices using the deflator in gross domestic capital formation published by the C&SD and commercial property price index provided by the Rating and Valuation Department.