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Analysis of Commodity Substitution Effect in Hong Kong's CPIs

Note by the Census and Statistics Department of Hong Kong, People's Republic of China

Summary

The monthly CPIs in Hong Kong are compiled using the Laspeyre formula by taking reference to a set of expenditure weights in the base year obtained from the Household Expenditure Survey (HES) and current price data from a monthly retail price survey. Hong Kong has completed the latest round of HES for 2009/10. Based on the results of the 2009/10 HES, an updated set of expenditure weights is available. This paper analyses the change in expenditure weights between the two base periods, i.e. 2009/10 and 2004/05, highlights the commodity substitution effect amongst related commodities/services and explains the factors underpinning the smaller year-on-year rate of changes in the new 2009/10-based CPIs series.

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I. Introduction

1.   The Consumer Price Index (CPI) is widely used as an indicator of inflation or deflation affecting consumers. It measures the cost of purchasing a fixed basket of goods and services over time. The monthly CPIs are compiled using the Laspeyre formula by combining a set of expenditure weights in the base year obtained from the five-yearly Household Expenditure Survey (HES) and price data from an on-going price survey conducted by the Census and Statistics Department (C&SD) in Hong Kong. With reference to the latest results of the 2009/10 HES, the expenditure ranges and weighting patterns of the CPI series have been updated. This paper aims to analyse the change in expenditure weights and the commodity substitution effect between 2004/05-based and 2009/10-based CPIs.

II. Expenditure ranges for different CPI series

2.   As households in different expenditure ranges have varying expenditure patterns, the impacts of consumer price changes on households in different expenditure ranges are different. In Hong Kong, separate CPI series relating to households in different expenditure ranges are compiled. The CPI(A) relates to about 50% of households in Hong Kong which are in the relatively low expenditure range, the CPI(B) relates to the next 30% of households in the medium expenditure range while the CPI(C) relates to the next 10% of households in the relatively high expenditure range. A Composite CPI is compiled based on the overall expenditure pattern of all the above households taken together to reflect the impact of consumer price changes on the household sector as a whole.

3.   The expenditure ranges for and percentage of households covered in the old 2004/05-based and new 2009/10-based CPI series are listed in Table 1.

Table 1
Delineation of the various CPI series

Index	Approximate percentage of households covered	Average monthly household expenditure during	
		October 2004 to September 2005	October 2009 to September 2010
CPI(A)	50%	$4,000 – $15,499	$4,500 – $18,499
CPI(B)	30%	$15,500 – $27,499	$18,500 – $32,499
CPI(C)	10%	$27,500 – $59,999	$32,500 – $65,999
Composite CPI	90%	$4,000 – $59,999	$4,500 – $65,999

4.   The remaining households which are not covered in the CPIs are those in the lowest or highest expenditure ranges. Also excluded are those households receiving Comprehensive Social Security Assistance.

III.   Results of the latest round of CPI rebasing exercise

5.   The latest round of HES was conducted in 2009/10 to collect information regarding household expenditure incurred during October 2009 to September 2010. Based on the results from the HES, the expenditure weights have been updated as listed in Annex 1.

6.   A notable observation in the 2009/10-based CPIs is the increase in expenditure weights on food and housing as compared with that in 2004/05, as mainly attributable to the continual increases in food prices and private housing rent. On the other hand, the 2009/10-based CPIs generally showed smaller rates of increase as compared with the old 2004/05-based indices, which is a feature mainly attributable to commodity substitution effect with the passage of time. A comparison of year-on-year rates of change for the 2004/05-based and 2009/10-based Composite CPI is shown in Chart 1.

Chart 1
Comparison of year-on-year rates of change for the 2004/05-based and 2009/10-based underlying Composite CPI[1]
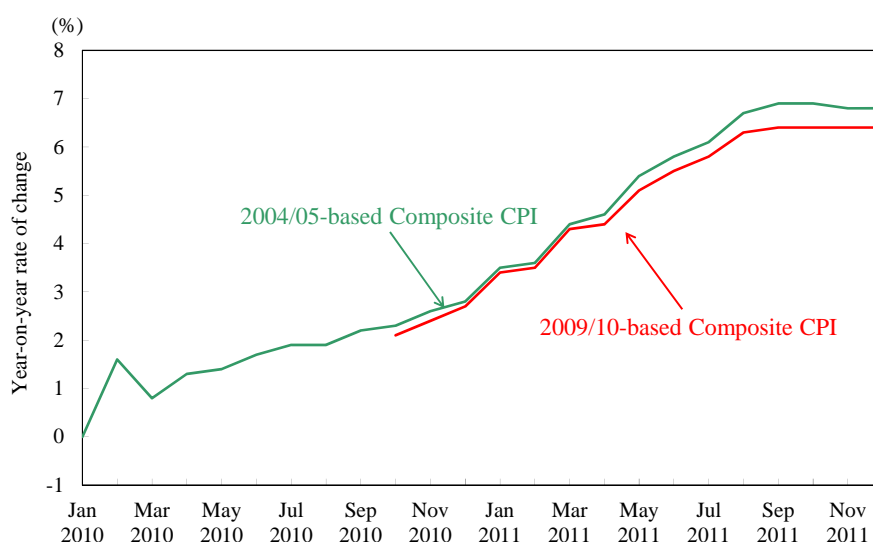
7.   The phenomenon of having smaller rates of change in the new CPI series amid enlarged increases in prices of food and private housing rents may apparently appear inconsistent. More in-depth analysis is presented below to explain such findings.

IV.   Factors Explaining Changes in Expenditure Weights

8.   The expenditure weight for each item in the CPI basket is the expenditure share of the item to the total expenditure of households on consumer goods and services. The changes in weights on each item mainly arise from the combined effect of two factors viz.: (i) changes in prices (P) and (ii) changes in consumption volume (Q). In some cases the change in expenditure were more driven by the price factor whereas in some other cases the

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1 Underlying CPI, with the effects of all Government's one-off relief measures (e.g. Government's payment of public housing rents, rates concessions, electricity charge subsidy) netting out, is used here to discern the inflationary trend more clearly.

change were more driven by the quantity factor. Moreover, the quantity factor was associated with the substitution behaviour of consumers but the extent of substitution varies across different commodities and services, depending on the elasticity of consumption.

9.   Regarding the relationship of expenditure weight for a specific item in the new 2009/10-based CPI series and the old 2004/05-based CPI series, it can be expressed as:

$$W_{New,k} = \frac{P_{New,k}\, Q_{New,k}}{\sum_i P_{New,i}\, Q_{New,i}}$$

$$= \frac{(P_{New,k} \times \frac{P_{Old,k}}{P_{Old,k}})(Q_{New,k} \times \frac{Q_{Old,k}}{Q_{Old,k}})}{\sum_i P_{New,i}\, Q_{New,i}}$$

$$= \frac{(P_{Old,k} Q_{Old,k} \times \frac{P_{New,k}}{P_{Old,k}} \times \frac{Q_{New,k}}{Q_{Old,k}})}{\sum_i P_{New,i}\, Q_{New,i}}$$

$$= \frac{(\frac{P_{Old,k} Q_{Old,k}}{\sum_i P_{Old,i}\, Q_{Old,i}} \times \frac{P_{New,k}}{P_{Old,k}} \times \frac{Q_{New,k}}{Q_{Old,k}})}{\frac{\sum_i P_{New,i}\, Q_{New,i}}{\sum_i P_{Old,i}\, Q_{Old,i}}}$$

$$= \frac{W_{Old,k} \times (1+\Delta P_k) \times (1+\Delta Q_k)}{1+\Delta PQ}$$

$$= \frac{\text{Expenditure weight in old base period} \times (1+\text{Change in } P) \times (1+\text{Change in } Q)}{1+\text{Change in total expenditure}}$$

where $W_{New,\,k}$ is the expenditure weight for commodity k in the new CPI series;
$W_{Old,\,k}$ is the expenditure weight for commodity k in the old CPI series;
$P_{New,\,i}$ is the price of commodity i in the new base period;
$P_{Old,\,i}$ is the price of commodity i in the old base period;
$Q_{New,\,i}$ is the quantity of commodity i purchased in the new base period;
$Q_{Old,\,i}$ is the quantity of commodity i purchased in the old base period.

10.   As epitomised in the above formula, the expenditure weight for a certain commodity in the new CPI series is the product of its corresponding expenditure weight in the old CPI series, price change and quantity change, over the change in total expenditure. By using the above formula, the changes in the expenditure weights between 2009/10 and 2004/05 can be decomposed into price (P) and quantity (Q) components, as illustrated in Annex 2. A summary can then be drawn to depict the relationship between the change in price and quantity factors, as shown in Table 2 below.

Table 2
Relationship between the change in price and quantity factors in 2004/05 and 2009/10 by commodity/service sections

Commodity/service section	Price change between 2009/10 and 2004/05 **lower** than change in the all-items index	Price change between 2009/10 and 2004/05 **higher** than change in the all-items index
Implied quantity **increased** in 2009/10 compared with 2004/05	• Meals bought away from home • Durable goods • Transport • Miscellaneous services	• Housing
Implied quantity **decreased** in 2009/10 compared with 2004/05	• Electricity, gas and water • Clothing and footwear	• Food (excluding meals bought away from home) • Alcoholic drinks and tobacco • Miscellaneous goods

11.   The decomposition in Table 2 illustrates that the change in the price of a commodity or service would usually affect the consumption volume. Commodity substitution effect was observed for commodity/service sections that recorded a price change lower than the overall price change while at the same time the implied consumption volume increased (or vice versa) over the past 5 years from 2004/05 to 2009/10. According to the decomposition presented in Annex 2, the commodity substitution effect was more pronounced in food, alcoholic drinks and tobacco, durable goods and miscellaneous goods.

V.   Analysis of Commodity Substitution Effect

12.   The general observation of the new CPI series to record smaller rates of increase than the old series is mainly due to the phenomenon that consumers tend to buy more of the goods and services with relatively smaller price increases (or large price decreases) and less for those with larger price increases (or smaller price decreases), i.e. the consumer substitution among commodities and services in response to relative price changes so as to maximise one's utility.

13.   Substitution effect may take place between the commodity/service groups or items under a certain section. Specifically, the lower rate of change in the 2009/10-based index series was mainly attributable to the substitution effect between groups, i.e. lower implied quantity consumed in food (excluding meals bought away from home) (-8.7% according to the results of the 2009/10 HES) with a relatively larger price increases over the past 5 years (+32.8% according to the Composite CPI). The opposite was observed in meals bought away from home, with 6.0% increase in implied quantity consumed while prices rose moderately by 13.2% over the past 5 years. The phenomenon also took place at more detailed levels, such as poultry, pork and beef, where relatively large price increases were recorded in Hong Kong between 2004/05 and 2009/10.

14.   For durable goods, compared with 2004/05, households spent a greater share of their expenditure on products such as information technology and telecommunication equipment and digital camera, the prices of which have been falling substantially over the five years. Regarding miscellaneous goods, the expenditure share on newspapers fell notably as compared with that in 2004/05, which may be related to the existence of free newspapers

and online news. The change in expenditure pattern in these sections had the effect of lowering the rate of change in the CPIs. On alcoholic drinks and tobacco, the expenditure weights for cigarette dropped significantly as compared with that in 2004/05, which may be the consequences of a 50% increase in tobacco duty in early 2009.

VI. Year-on-year Rates of Change in the CPI

15.   Underpinned largely by the commodity substitution effects across two base periods, CPIs based on fixed consumption pattern tend to over-estimate price increases or under-estimate price decreases over time. As such, the year-on-year rates of change in the new 2009/10-based Composite CPI generally showed smaller increases as compared with that in the old 2004/05-based series. This phenomenon is consistent with that observed in previous rounds of CPI rebasing exercises in Hong Kong.

16.   As presented in Annex 3, the magnitude of smaller rates of change in the new 2009/10-based Composite CPI ranged from 0.1 to 0.5 percentage point, with the differences enlarging gradually when it is further away from the base period (as shown in Chart 1).

VII. Concluding Remarks

17.   By decomposing the change in expenditure weights between 2004/05 and 2009/10 into price and consumption volume components, it is revealed that change in consumption behaviour were mainly more noticeable in commodity/service sections as food, alcoholic drinks and tobacco, durable goods and miscellaneous goods. The rather small magnitude of the substitution effect observed further affirms the current practice of updating the expenditure weights of CPI once every five years, which should strike a good balance on the accuracy of CPI and the resource implications.

Annex 1

Comparison of expenditure weights between 2004/05-based and 2009/10-based Composite CPI at commodity/service section level

Commodity/service section	Composite CPI		CPI(A)		CPI(B)		CPI(C)	
	2004/05	2009/10	2004/05	2009/10	2004/05	2009/10	2004/05	2009/10
	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Food	26.94	27.45	32.10	33.68	27.32	27.16	20.41	20.87
Meals bought away from home	*(16.86)*	*(17.07)*	*(18.63)*	*(19.23)*	*(17.65)*	*(17.9)*	*(13.74)*	*(13.55)*
Food (excluding meals bought away from home)	*(10.08)*	*(10.38)*	*(13.47)*	*(14.45)*	*(9.67)*	*(9.26)*	*(6.67)*	*(7.32)*
Housing	29.17	31.66	30.54	32.19	27.70	31.43	29.66	31.36
Electricity, gas and water	3.59	3.10	4.84	4.36	3.37	2.84	2.45	2.03
Alcoholic drinks and tobacco	0.87	0.59	1.35	0.91	0.79	0.56	0.42	0.29
Clothing and footwear	3.91	3.45	2.81	2.60	4.28	3.45	4.67	4.39
Durable goods	5.50	5.27	4.01	3.73	5.67	5.73	6.99	6.39
Miscellaneous goods	4.78	4.17	4.68	3.87	4.76	4.17	4.91	4.49
Transport	9.09	8.44	8.07	7.22	9.05	8.35	10.35	9.93
Miscellaneous services	16.15	15.87	11.60	11.44	17.06	16.31	20.14	20.25
Overall	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Annex 2

Decomposition of the change in expenditures between 2009/10 and 2004/05 into price and quantity components

Commodity/service section	Average monthly household expenditure in		Change in expenditure	Change in Composite CPI	Implied change in quantity
	2004/05	2009/10			
	(HK$)	(HK$)	(%)	(%)	(%)
Food	4,863	5,859	20.5	20.5	0.0
Meals bought away from home	*3,078*	*3,695*	*20.0*	*13.2*	*6.0*
Food (excluding meals bought away from home)	*1,785*	*2,164*	*21.2*	*32.8*	*-8.7*
Housing	5,775	7,093	22.8	21.2	1.3
Electricity, gas and water	646	630	-2.5	5.4	-7.5
Alcoholic drinks and tobacco	152	133	-12.5	16.9	-25.1
Clothing and footwear	812	861	6.0	10.3	-3.9
Durable goods	868	886	2.1	-17.9	24.3
Miscellaneous goods	937	920	-1.8	13.8	-13.7
Transport	1,793	1,792	-0.1	3.8	-3.7
Miscellaneous services	3,037	3,449	13.6	5.0	8.1
All-items	**18,884**	**21,623**	**14.5**	**13.3**	**1.1**

Note: Average monthly household expenditure figures above refer to all households covered in the 2004/05 and 2009/10 rounds of Household Expenditure Survey (HES). The HES covered all land domestic households in Hong Kong, except households receiving Comprehensive Social Security Assistance (CSSA) which were covered in a special survey along with the HES. Marine households and collective households were not included in the HES. Also not included were those households which were away from Hong Kong during the reference period of the survey.

Annex 3

Comparison of year-on-year rates of change for the 2004/05-based and 2009/10-based underlying Composite CPI

		Composite CPI		
		2004/05	2009/10	Diff.
		(%)	(%)	(% pt)
2010	Oct	2.3	2.1	-0.2
	Nov	2.6	2.4	-0.2
	Dec	2.8	2.7	-0.1
2011	Jan	3.5	3.4	-0.1
	Feb	3.6	3.5	-0.1
	Mar	4.4	4.3	-0.1
	Apr	4.6	4.4	-0.2
	May	5.4	5.1	-0.3
	Jun	5.8	5.5	-0.3
	Jul	6.1	5.8	-0.3
	Aug	6.7	6.3	-0.4
	Sep	6.9	6.4	-0.5
	Oct	6.9	6.4	-0.5
	Nov	6.8	6.4	-0.4
	Dec	6.8	6.4	-0.4

Note: Underlying CPI, with the effects of all Government's one-off relief measures (e.g. Government's payment of public housing rents, rates concessions, electricity charge subsidy) netting out, is used here to discern the inflationary trend more clearly.