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Commodity prices and consumer price inflation in Hong Kong

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Abstract

This article explores the relationship between international commodity prices and consumer prices in Hong Kong with quarterly data from 1984 to 2021. Stationarity and cointegration tests show that the World Bank commodity price indices for agriculture, energy and metal and Hong Kong's Composite Consumer Price Index (CCPI) are nonstationary, but cointegrated, indicating that a vector error correction model is the most appropriate. Reflecting the relatively greater importance of food in the CCPI expenditure basket, the long-run elasticity of consumer prices with respect to agriculture prices is about 0.1.

商品價格及香港的消費物價通脹

摘要

本文利用 1984 年至 2021 年間的季度數據，探討國際商品價格和香港消費物價的關係。平穩性檢定及共整合檢定顯示世界銀行的農產品、能源及金屬價格指數和香港的綜合消費物價指數均為非平穩，但存在共整合關係，因此向量誤差修正模型為最適合的模型。反映綜合消費物價指數開支項目中食品的重要性較高，消費物價相對於農產品價格的長期彈性約 0.1。

I. INTRODUCTION

1. Commodity prices are often seen as leading indicators of inflation. This is mainly for two reasons. First, since commodities are inputs to manufactured goods, changes in commodity prices have a direct impact on production costs and eventually consumer prices. Second, because commodity prices are set in competitive auction markets, they adjust much more quickly in response to economic shocks. The idea has been so popular that, in the early 1980s, the US Congress considered requiring the Federal Reserve to target commodity prices on the theory that general price stability would follow as a matter of course. While commodity prices were ultimately considered too volatile for this to work[1], they continue to capture the imagination and their implications for inflation remain a frequently-asked and pertinent question.

2. This article explores the relationship between global commodity prices and consumer price inflation in Hong Kong. It is organised as follows. The next section provides an overview of the data, and the third section shows that the price variables are cointegrated. The fourth section quantifies their relationship with a vector error correction model. The fifth section concludes.

II. DATA

3. Data on commodity prices are sourced from the World Bank's monthly "Pink Sheet" database[2], which includes agriculture, energy and metal (metals & minerals) commodity price indices that date back to 1977. The commodity prices constituting the indices are in nominal US dollars. Broadly speaking, the agriculture index is mainly food and beverages (75%), with the remainder consisting of agricultural raw materials such as timber, rubber, or cotton. The energy index is mainly crude oil (85%), but also includes natural gas and coal. The metal index excludes precious metals. The World Bank does not publish an overall commodity price index.

4. Consumer prices are measured with Hong Kong's Composite Consumer Price Index (CCPI)[3], which is published by the Census and Statistics Department. The CCPI dates back to 1974 and reflects the expenditure pattern of the middle 90 percent of households in Hong Kong. Though there is some variation in the weights over time,

[1] Woodford, M. 1994. "Nonstandard indicators for monetary policy: can their usefulness be judged from forecasting regressions?" *Monetary Policy*. Chicago: University of Chicago Press, pp. 95-115. https://www.nber.org/system/files/chapters/c8330/c8330.pdf

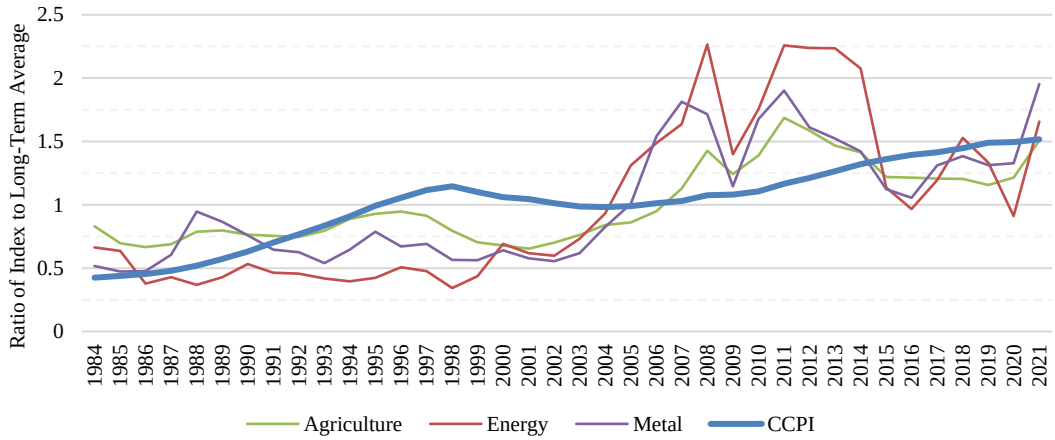
[2] World Bank. (n.d.) "Commodity markets." https://www.worldbank.org/commodities

[3] Census and Statistics Department. (n.d.) "Table 52: Consumer Price Indices (October 2019 – September 2020 = 100)." https://www.censtatd.gov.hk/en/web_table.html?id=52

the most significant items in the CCPI are housing and food, while expenditures more related to energy and metal commodities comprise relatively smaller shares of the index. For instance, food prices comprise 27% of the 2019/20 rebased series, while electricity, gas and water and transport prices account for 9% of the series and durable and miscellaneous goods prices account for 7%. As a result, it is generally expected that agriculture commodity prices should have the most direct impact on the CCPI. However, other types of commodity prices may still lead the CCPI by responding more quickly to broad-based economic shocks.

5. The three commodity price indices and Hong Kong's CCPI, relative to their long-term (1984-2021) averages, are shown in **Chart 1**. 1984 is Hong Kong's first full year under the Linked Exchange Rate System. **Chart 1** shows that, though the commodity price indices are quite volatile, there is at least some visual evidence for the theory that commodity prices lead consumer price inflation in Hong Kong. For instance, a rise in metals prices in the late 1980s, attributable to high levels of investment and demand for metal-intensive capital goods[4], preceded Hong Kong's double-digit CPI inflation from 1989 to 1991. Later, the second half of the 1990s saw a broader-based decline in commodity prices as production in Asian newly industrialised economies fell and the Asian financial crisis took hold[5], but Hong Kong did not see consumer price deflation until the end of that period. Similarly, accelerating economic growth in emerging market economies in the early 2000s led to another turnaround in commodity prices[6], but Hong Kong did not exit deflation until 2004 amid the strong post-SARS economic recovery.

Chart 1: World Bank Commodity Price Indices and Hong Kong's CCPI



[4] Choe, B. 1990. "After the metals market boom." *Finance & Development* 27(2), pp. 44-45. https://doi.org/10.5089/9781451952476.022

[5] Matthies, K. 1998. "Commodity prices continue to fall." *Internomics* 33(5), pp. 245-248. https://www.intereconomics.eu/archive/year/1998/number/5.html

[6] Helbling, T. 2012. "Commodities in boom." *Finance & Development* 49(2), pp. 30-31. https://www.imf.org/external/pubs/ft/fandd/2012/06/helbling.htm

6. Commodity prices are also affected by supply-side factors. For instance, because investment in mining and oil capacity is costly and takes many years to come online, producers may be reluctant to expand supply until they are sure that demand will be sustained, causing prices to spike in the short term. Developments in specific markets, such as poor weather, can also disrupt supply. Consequently, while certain long-run trends may be visible in the data, the implications of a specific change in commodity prices for consumer price inflation will depend on the underlying reasons and vary from case to case. For example, whether the recent upturn in commodity prices amid the COVID-19 pandemic will translate into sustained higher inflation depends critically on how quickly global supply can regain its footing.

III. COINTEGRATING RELATIONSHIPS

7. Modelling the relationship between commodity prices and consumer prices in Hong Kong requires first establishing whether the variables are stationary. If they are, the model can simply be estimated in levels. Otherwise, a vector error correction or differenced model may be needed, depending on whether or not a cointegrating relationship exists among the variables. For compatibility with later analysis, the stationarity and cointegration tests are undertaken with quarterly data (1984-2021, or 152 quarters in all), and the CCPI and commodity indices are logarithms of the quarterly figures.

8. The results of Phillips-Perron[7] stationarity tests, with time trends, of the variables and their first differences are given in **Table 1**. The Phillips-Perron test is an extension of the traditional Dickey-Fuller stationarity test[8], except that it uses Newey-West standard errors[9] to correct for heteroscedasticity and serial correlation. As suggested by Newey and West, the number of lags used in calculating the standard errors is equal to the integer part of $4(N/100)^{2/9}$, where N is the sample size. This works out to four lags. The results in **Table 1** show that, in all four cases, the hypothesis that the variables in levels are nonstationary (I(1)) cannot be rejected. However, the hypothesis that the first differences are nonstationary (i.e. that the original variable is I(2)) is always rejected. Thus, all four variables are treated as I(1) in the model.

[7] Phillips, P. and P. Perron. 1988. "Testing for a unit root in time series regression." *Biometrika* 75(2), pp. 335-346. https://www.jstor.org/stable/2336182

[8] Dickey, D., and W. Fuller. 1979. "Distribution of the estimators for autoregressive time series with a unit root." *Journal of the American Statistical Association* 74(366), pp. 427-431. https://www.jstor.org/stable/2286348

[9] Newey, W., and K. West. 1987. "A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix." *Econometrica* 55(3), pp. 703-708. https://www.jstor.org/stable/1913610

Table 1: Phillips-Perron Stationarity Tests*

Consumer / Commodity Price Index	Level		First Difference	
	Z_τ	p	Z_τ	p
CCPI	−1.698	0.7519	−8.728**	0.000
Agriculture	−2.332	0.4161	−8.281**	0.000
Energy	−2.739	0.2203	−9.533**	0.000
Metal	−2.596	0.2817	−8.035**	0.000

Notes (*) : Tests are on the natural logarithm of the relevant price index and include a time trend. The null hypothesis is the hypothesis that $\rho = 1$ in the relation $y_t = \alpha + \rho y_{t-1} + \delta t + \epsilon_i$, where y_t is the variable to be tested.
(**) : The null hypothesis is rejected at the 5% level.

9. Though all four variables tested as I(1), there still may be a long-term relationship (i.e., a cointegrating relationship) between them if they share common stochastic trends. Theoretically, common stochastic trends could arise if input prices eventually feed into the CCPI or if the variables all respond to broader-based economic shocks, an idea that was visually supported by **Chart 1**. To formally investigate this possibility, **Table 2** shows the results of Johansen cointegration tests[10] for the variables in **Table 1**. As suggested by the Bayesian information criterion, the Johansen tests all incorporate one lag. Two types of tests are considered: a set of tests for the whole system, and pairwise tests between the CCPI and each of the commodity price indices. The pairwise tests are undertaken in order to rule out the possibility that the cointegrating relationship exists only among the commodity price variables.

Table 2: Johansen Cointegration Tests*

Variables	H_0: $r = 0$		H_0: $r \leq 1$	
	Trace Statistic	5% Critical Value	Trace Statistic	5% Critical Value
CCPI, Agriculture, Energy, Metal	116.23**	62.99	39.66	42.44
CCPI, Agriculture	65.43**	25.32	2.49	12.25
CCPI, Energy	30.51**	25.32	5.71	12.25
CCPI, Metal	60.11**	25.32	4.71	12.25

Notes (*) : Tests are of the null hypothesis that the cointegrating rank r (number of linearly independent cointegrating vectors) of the system is less than or equal to the number indicated. The cointegrating regression includes a time trend.
(**) : The null hypothesis is rejected at the 5% level.

[10] Johansen, S. 1995. *Likelihood-based inference in cointegrated vector autoregressive models.* Oxford: Oxford University Press.

10. The results in **Table 2** show that the null hypothesis of no cointegrating relationship among the four variables is strongly rejected, supporting the theory that they share at least one common stochastic trend. Moreover, the CCPI appears to be cointegrated with each of the commodity price indices individually, ruling out the possibility that the cointegrating relationship only exists among the three commodity price indices themselves. This finding is different from prior research that did not find evidence for a cointegrating relationship between commodity and consumer prices in Hong Kong[11], which may be because more data are now available.

IV. MODEL

11. The results in the previous section suggest that a vector error correction model is the most suitable model of the relationship between inflation and commodity prices. For the short-run dynamics, a vector error correction model starts with a vector autoregression model in first differences. A term based on dislocations from the long-run cointegrating relationship is then added so these can be gradually corrected over time.

12. Formally, the vector error correction model is written as

$$\Delta \boldsymbol{y}_t = \boldsymbol{\gamma} + \boldsymbol{\Gamma} \cdot \Delta \boldsymbol{y}_{t-1} + \boldsymbol{\lambda} \cdot \left(y_{1,t-1} + \boldsymbol{\beta} \cdot \boldsymbol{y}_{2,t-1} + \mu + \rho \cdot t \right) + \varepsilon_t$$

where $\boldsymbol{y}_t$ are the variables in the system (separated into the first variable $y_{1,t}$ and the other variables $\boldsymbol{y}_{2,t}$ as needed), $\boldsymbol{\gamma}$ is a vector of constants and the differenced vector autoregression component $\boldsymbol{\Gamma} \cdot \Delta \boldsymbol{y}_{t-1}$ captures the short-run dynamics. The cointegrating relationship term $\left(y_{1,t-1} + \boldsymbol{\beta} \cdot \boldsymbol{y}_{2,t-1} + \mu + \rho \cdot t \right)$ is equal to zero when all the variables are in equilibrium with each other; otherwise, it is positive if the first variable in the system is above its long-run expected value and negative if the first variable in the system is below its long-run expected value. The error correction coefficients $\boldsymbol{\lambda}$ then act to push the system back to its equilibrium.

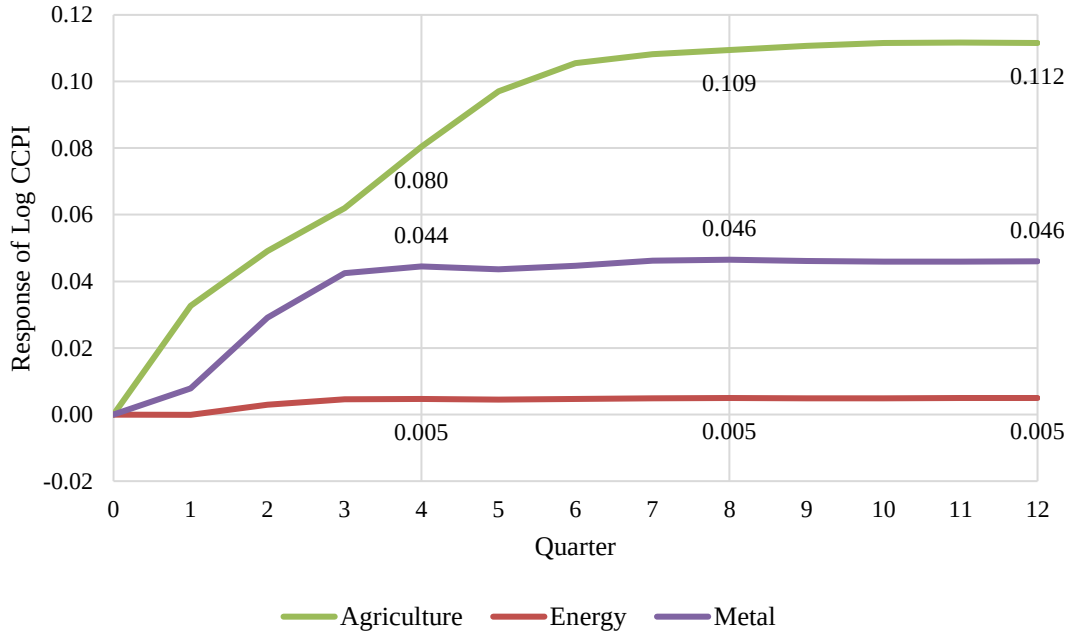
13. The first variable in the system $y_{1,t}$ is the log CCPI, the main variable of interest. The other variables are the log commodity price indices for agriculture, energy and metal; log real GDP; the seasonally adjusted unemployment rate; the log import-weighted effective exchange rate index for the Hong Kong dollar; and the US federal funds rate. The non-commodity price variables aim to capture other factors related to

[11] Cutler, J., C. Chan and U. Li. 2005. "The relationship between commodity and consumer prices in Mainland China and Hong Kong." *HKMA Quarterly Bulletin* 43, pp. 16-31. https://www.hkma.gov.hk/media/eng/publication-and-research/quarterly-bulletin/qb200506/fa2.pdf

consumer prices, namely aggregate demand, labour market tightness, exchange rates, and monetary policy via the linked exchange rate system.

14. Given the complex dynamics of the system, the coefficients of the vector error correction model are difficult to interpret directly. However, a general idea of the change in the future path of consumer prices that can be expected given a current change in commodity prices[12] can be obtained by inspecting the impulse response functions. The responses of consumer prices over a three year horizon to initial changes in agriculture, energy and metal prices are plotted in **Chart 2**.

Chart 2: Impulse Responses of Log Consumer Prices to Log Commodity Prices



15. A number of salient observations can be made from the impulse responses in **Chart 2**. First, commodity price shocks largely filter through to consumer prices within two years, consistent with the observations from **Chart 1** and a common time frame in a monetary policy context[13]. Second, the impact of agriculture prices is notably larger than the impact of metal and energy prices, in line with the larger weighting of food in the CCPI and also consistent with findings from previous research[14].

[12] Feedback in the other direction, from Hong Kong consumer prices to global commodity prices, is taken to be negligible given the small size of Hong Kong's economy in a global setting.

[13] Batini, N. and E. Nelson. 2003. "The lag from monetary policy actions to inflation: Friedman revisited." *International Finance* 4(3), pp. 381-400. https://doi.org/10.1111/1468-2362.00079

[14] Cutler, J., C. Chan and U. Li, *op. cit.*

16. Interpreted, the figures for agriculture mean that, if agriculture commodity prices to rise by 1%, then consumer prices are expected to rise by about 0.08% within one year and 0.11% within two years. Put another way, the elasticity of consumer prices with respect to agriculture commodity prices within two years is about 0.1[15]. The magnitude of this effect is generally as expected given the expenditure share of food in Hong Kong's CCPI[16].

V. CONCLUSIONS

17. The road from international commodity prices to domestic consumer prices is a long and winding one, passing through production, distribution, taxes, and subsidies and often criss-crossing international boundaries before reaching the end. As seen in this article and elsewhere, the whole process can take more than a year to complete. But precisely for this reason, and because international commodities are priced on highly efficient global auction markets, their prices contain important signals as to where consumer prices are eventually headed. In Hong Kong's case, as in many places, agriculture prices are especially relevant, though prices in other markets such as metals have signalled upturns in the past, notably in the late 1980s. The estimated long-run elasticity of Hong Kong's CCPI with respect to the World Bank's agricultural commodity index of about 0.1 is generally as expected given the share of food in Hong Kong's CCPI expenditure basket and experiences of other economies.

[15] When consumer prices are disaggregated into separate categories, the results are qualitatively intuitive (e.g. a larger effect for basic food, and a smaller one for meals eaten out), but statistically significant differences do not materialise.

[16] Gelos, G. and Y. Ustyugova. 2017. "Inflation responses to commodity price shocks: how and why do countries differ?" *Journal of International Money and Finance* 72, pp. 28-47. https://doi.org/10.1016/j.jimonfin.2016.10.001