

Disentangling wages and consumer price inflation in Hong Kong

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Abstract

This article explores the relationship between nominal wages and consumer prices in Hong Kong with quarterly data from 1984 to 2021. As predicted by theory, consumer prices and productivity-adjusted nominal wages track each other over the long term. In the short term, Granger causality tests and a differenced vector autoregression model show that consumer prices tend to respond more quickly to external economic shocks. Consequently, over the past few decades, consumer prices have been a leading indicator of productivity-adjusted nominal wages.

解構香港的工資及消費物價通脹

摘要

本文利用 1984 年至 2021 年間的季度數據，探討香港名義工資和消費物價的關係。正如理論所預測，長期而言，消費物價和經生產力調整的名義工資兩者的走勢亦步亦趨。在短期，格蘭傑因果關係檢驗及差分向量自回歸模型顯示消費物價傾向較快對外圍經濟衝擊有反應。因此，消費物價在過去數十年一直是經生產力調整的名義工資的領先指標。

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

I. INTRODUCTION

1. The recent surge in global inflation has led to renewed interest in whether inflation leads to higher wages or the other way around. Yet, economic theory is agnostic on this point. In a simple world where labour is compensated according to its marginal product in real terms, consumer prices should track productivity-adjusted nominal wages on a one-to-one-basis. More realistically, product and labour markets are both subject to frictions and adjustment costs. For instance, an increase in demand may cause consumer prices to rise first, while developments in the labour market could affect wages before filtering through to prices. If past inflation factors into current wage demands, the two could even reinforce each other in a wage-price spiral¹. Consequently, whether consumer price inflation tends to predict nominal wage increases or vice versa is ultimately an empirical question.

2. This article explores the relationship between wages and consumer prices in Hong Kong. It is organised as follows. The next section introduces stylised facts on wages and prices in Hong Kong alongside relevant concepts from the literature. The third section establishes their time series properties and finds that consumer prices help predict wages, but not vice versa. The fourth section quantifies their relationship with a differenced vector autoregression (VAR) model. The fifth section concludes.

II. CONCEPTS AND STYLISTED FACTS

3. The theory that consumer prices should track productivity-adjusted nominal wages is based on the idea of a profit-maximising firm that is a price taker in both the labour market and the product market. The firm hires L workers and produces $f(L)$ output; after selling its output at price P , its total revenue is $P \cdot f(L)$. Maximising profit requires that the firm hire labour until its marginal revenue $P \cdot f'(L)$ equals the marginal cost (or wage) W , or until $P \cdot f'(L) = W$. Taking the logarithm of both sides and writing the period-to-period change yields

$$\Delta \ln(P_t) + \Delta \ln(f'(L)_t) = \Delta \ln(W_t)$$

where $\Delta \ln(P_t)$ is inflation, $\Delta \ln(f'(L)_t)$ is the change in labour productivity, and $\Delta \ln(W_t)$ is the change in nominal wages². In this ideal world, inflation moves in lockstep with productivity-adjusted nominal wages $\Delta \ln(W_t) - \Delta \ln(f'(L)_t)$.

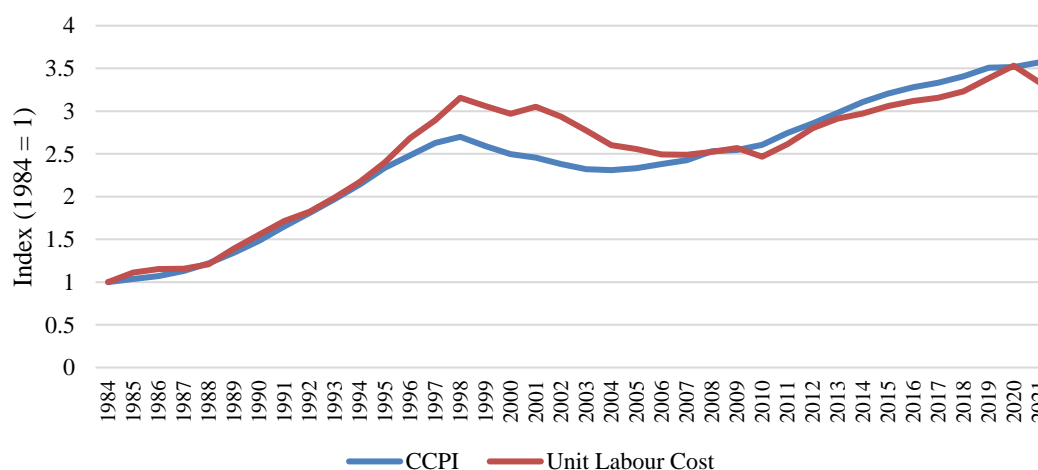
¹ Campbell, J. and E. Rissman. 1994. "Long-run labor market dynamics and short-run inflation." *Economic Perspectives*, Federal Reserve Bank of Chicago, 18(2), pp. 15-27.
<https://www.chicagofed.org/publications/economic-perspectives/1994/04marapr1994-part2-campbell>

² Ibid.

4. In this article, inflation is measured with Hong Kong’s Composite Consumer Price Index (CCPI), which reflects the expenditure pattern of the middle 90 percent of households in the city. Productivity-adjusted nominal wages are measured according to Hong Kong’s unit labour cost (payroll per unit of output), proxied as the nominal overall index of payroll³ per person engaged divided by real GDP per person employed. The statistics on inflation and unit labour costs are sourced from the Census & Statistics Department (C&SD).

5. The two time series, normalised to 1984, are plotted in **Chart 1**. 1984 is chosen as the starting point because it is Hong Kong’s first full year under the Linked Exchange Rate System, with considerable implications for prices and inflation. By and large, as theory would predict, the two series track each other over the long term. Put another way, over the long term, increases in nominal wages can only outstrip inflation to the extent that they are underpinned by gains in productivity⁴. However, wages are also subject to notable inertia. For instance, **Chart 1** shows that, starting from 1997, unit labour costs started to outpace inflation as the economy fell into recession amid the Asian financial crisis. Comparatively speaking, it took more time for unit labour costs to adjust, and the series did not intersect again until 2008. Years of deflation around that time may have made the adjustment especially difficult due to downward nominal wage rigidities⁵. After 2008, unit labour costs lagged slightly behind the CCPI.

Chart 1: Hong Kong’s CCPI and Unit Labour Cost



³ C&SD publishes both “payroll indices” and “wage indices”. C&SD’s payroll indices are more closely aligned with the concept of “wages” in this article because payroll is a more comprehensive measure of labour compensation that includes overtime payments and discretionary bonuses. Moreover, the payroll enquiry covers more industries than the wage enquiry and includes managers and professionals.

⁴ Though outside the scope of this article, real wages as measured by C&SD’s overall real index of payroll per person engaged grew markedly over the same period, to 2.5 times its 1984 level in 2021. This shows that productivity-linked gains in wages have been quite substantial.

⁵ Bewley, F. 1999. *Why wages don’t fall during a recession*. Cambridge, MA: Harvard University Press. <https://www.jstor.org/stable/j.ctv1pncnqx>

6. Though the theory of the profit-maximising firm is useful for explaining how wages and prices relate to each other, it says little about the factors that drive them both. Taking a more macro perspective leads to Gordon’s “triangle” model, in which inflation—and, by necessary implication, increases in productivity-adjusted nominal wages—depends on the “three corners” of demand, supply, and inertia. In this model, demand is aggregate demand, proxied by output or unemployment; supply is an explicit supply shock, like changes in commodity prices or price controls; and inertia arises from various factors such as expectations (e.g., in a wage-price spiral), fixed-term wage and price contracts, and lags between input and output prices⁶.

7. One of Gordon’s more striking findings is that, in the case of the US, productivity-adjusted nominal wages and prices are so tightly linked that, from an inflation forecasting perspective, a separate wage equation is redundant—once past inflation is accounted for, past changes in wages do not make any further statistical contribution to the forecast⁷. Much of the following literature on the topic has generally supported this conclusion⁸. Nevertheless, a separate wage equation is still needed when the object is to test hypotheses on how wages and prices relate to each other; in this case, the same set of supply and demand variables will generally be applicable to both⁹.

III. TIME SERIES PROPERTIES OF WAGES AND PRICES

8. Constructing a model of the relationship between consumer prices and productivity-adjusted nominal wages in Hong Kong requires first establishing whether the variables are stationary, and, if they are non-stationary, whether a cointegrating relationship exists between them. Generally, it is expected that consumer prices in Hong Kong are non-stationary¹⁰. Theoretically, a long-run equilibrium between consumer prices and unit labour costs suggests the two should be cointegrated, though a weak relationship may not show up as statistically significant in the data.

⁶ Gordon, R. 2011. “The history of the Phillips curve: consensus and bifurcation.” *Economica* 78(309), pp. 10-50. <https://www.jstor.org/stable/41236106>

⁷ Gordon, R. 1998. “The role of wages in the inflation process.” *American Economic Review* 78(2), pp. 276-283. <https://www.jstor.org/stable/1818136>

⁸ Hu, L. and M. Toussaint-Comeau. 2010. “Do labor market activities help predict inflation?” *Economic Perspectives*, Federal Reserve Bank of Chicago, 34(2), pp. 52-63. <https://www.chicagofed.org/publications/economic-perspectives/2010/2q-hu-toussaint-comeau>

⁹ Gordon, R. 1981. “Inflation, flexible exchange rates, and the natural rate of unemployment.” NBER Working Paper No. 708. <https://www.nber.org/papers/w0708>

¹⁰ 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>

9. To test stationarity, the results of Phillips-Perron¹¹ tests of the variables (in natural logarithms and quarterly from 1984 to 2021) and their first differences are given in **Table 1**. Of these, the unit labour cost exhibited notable seasonality and has been deseasonalised with the Holt-Winters¹² algorithm. The tests, which are robust to heteroscedasticity and serial correlation, are based on Newey-West¹³ standard errors with four lags¹⁴. The results in **Table 1** show that the hypotheses that the CCPI and the unit labour cost are non-stationary in levels cannot be rejected at any significance level. However, the hypotheses that they are non-stationary in first differences are strongly rejected. Consequently, they will both be treated as I(1) in the analysis.

Table 1: Phillips-Perron Stationarity Tests*

Variable	Level		First Difference	
	Z_{τ}	p	Z_{τ}	p
CCPI	-1.698	0.7519	-8.728**	0.000
Unit Labour Cost	-1.639	0.7767	-9.169**	0.000

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

(**): The null hypothesis is rejected at the 5% level.

10. Since the variables are both non-stationary, and **Chart 1** showed that they tend to track each other, they may be cointegrated. To see if they are, **Table 2** shows the results of augmented Engle-Granger¹⁵ tests with six lags as suggested by the Bayesian information criterion. The Engle-Granger test is based on the residuals from a regression of one of the variables on the other. If the null hypothesis that the residuals are I(1) is not rejected, then the null hypothesis of no cointegration is not rejected. Compared to the alternative Johansen¹⁶ test, the Engle-Granger test imposes fewer distributional assumptions, but it cannot be used to infer the number of linearly independent cointegrating vectors. The latter is not an issue in a two-variable I(1) system where there can be at most one such vector.

¹¹ 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>

¹² Winters, P. 1960. "Forecasting sales by exponentially weighted moving averages." *Management Science* 6(3), pp. 324-342. <https://www.jstor.org/stable/2627346>

¹³ 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>

¹⁴ Newey and West suggest setting the number of lags equal to the integer part of $4(N/100)^{2/9}$, where N is the sample size. In this case, N is 152 quarters.

¹⁵ Engle, R. and C. Granger. 1987. "Co-integration and error correction: representation, estimation, and testing." *Econometrica* 55(2), pp. 251-176. <https://www.jstor.org/stable/1913236>

¹⁶ Johansen, S. 1995. *Likelihood-based inference in cointegrated vector autoregressive models*. Oxford: Oxford University Press.

Table 2: Engle-Granger Cointegration Tests*

Dependent Variable	Statistic	Critical Values		
	Z_{τ}	10%	5%	1%
CCPI	-1.251	-3.073	-3.377	-3.970
Unit Labour Cost	-1.359	-3.073	-3.377	-3.970

Notes (*): Tests are on the natural logarithms of the listed variables. The null hypothesis of no cointegration is the hypothesis that the residuals from a regression of the dependent variable on the other variable are I(1). The null hypothesis is rejected at the indicated confidence level if the test statistic is more negative than the corresponding critical value.

11. The results in **Table 2** show that, regardless of which variable is chosen as the dependent variable¹⁷, the null hypothesis of no cointegration is not rejected at any significance level. Conceivably, this is because the convergence in **Chart 1** is rather weak, taking as long as a decade or more to play out fully. Consequently, the system is modelled as a VAR in first differences, without any error correction term¹⁸.

12. The next section will examine a fuller model with covariates to capture supply and demand factors. For robustness, however, it is valuable to check whether, solely looking at the two series by themselves, the earlier-mentioned (para. 7) finding from the literature that prices predict productivity-adjusted nominal wages but not vice versa is true in Hong Kong as well. To this end, **Table 3** presents the results of Granger causality tests based on a bivariate differenced VAR model, with five lags as suggested by the Bayesian information criterion¹⁹. **Table 3** shows that, indeed, after accounting for past wage changes, the hypothesis that prices do not predict wages is rejected at the 5% level, but the reverse hypothesis is not rejected at the 5% level. Put another way, the statistical evidence for Granger causality from prices to wages is much stronger than the statistical evidence for Granger causality from wages to prices.

Table 3: Granger Causality Tests (Bivariate Model)*

Null Hypothesis	F	Critical Value (5%)	p
CCPI does not predict Unit Labour Cost	9.30**	2.28	0.000
Unit Labour Cost does not predict CCPI	2.10	2.28	0.067

Notes (*): Tests are on the natural logarithms of the listed variables. The null hypothesis that A does not predict B is the hypothesis that, in a differenced VAR model with five lags, the coefficients on A in the equation for B are equal to zero.

(**): The null hypothesis is rejected at the 5% level.

¹⁷ In small samples, the test result could conceivably be different depending on which variable is regressed on the other.

¹⁸ An alternative model that included long-run error correction terms was not stable.

¹⁹ It is expected that, in a differenced model, there would be one less lag than in the corresponding level model.

IV. MODEL

13. As suggested by the time series properties of the variables, productivity-adjusted nominal wages and prices are modelled with a first-differenced VAR model with five lags. Moreover, in line with Gordon’s triangle model, additional exogenous covariates are added in order to control for supply and demand factors. The third corner of the triangle, inertia, is covered by the lagged endogenous variables. Formally, the VAR model is written as

$$\Delta \mathbf{y}_t = \boldsymbol{\gamma} + \sum_{p=1}^5 \boldsymbol{\Phi}_p \cdot \Delta \mathbf{y}_{t-p} + \sum_{q=1}^5 \boldsymbol{\Gamma}_q \cdot \Delta \mathbf{X}_{t-q} + \boldsymbol{\varepsilon}_t$$

where \mathbf{y}_t are the log CCPI and log unit labour costs as defined earlier.

14. The exogenous variables \mathbf{X}_t in the model are log real GDP; the seasonally adjusted unemployment rate; the log import-weighted effective exchange rate index for the Hong Kong dollar; the US federal funds rate; and the log World Bank “Pink Sheet” commodity price index for agriculture^{20,21}. Generally, the first two exogenous variables relate to demand-side factors while the last three are more supply-related. However, they all enter the model the same way—i.e., all five exogenous variables appear in both the price equation and the wage equation—regardless of how they are classified.

15. Adding exogenous variables to the model sharpens the earlier observation from **Table 3** that prices tend to predict productivity-adjusted nominal wages but not vice versa. Corresponding Granger causality tests for the full model are given in **Table 4**. When the exogenous variables are added, statistical evidence against the hypothesis that prices do not predict wages remains strong, but the reverse hypothesis is not rejected at any conventional significance level.

Table 4: Granger Causality Tests (Multivariate Model)*

Null Hypothesis	<i>F</i>	Critical Value (5%)	<i>p</i>
CCPI does not predict Unit Labour Cost	4.65**	2.30	0.001
Unit Labour Cost does not predict CCPI	1.00	2.30	0.419

Notes (*): Tests are on the natural logarithms of the listed variables. The null hypothesis that A does not predict B is the hypothesis that, in a differenced VAR model with five lags and exogenous covariates, the coefficients on A in the equation for B are equal to zero.

(**): The null hypothesis is rejected at the 5% level.

²⁰ World Bank. (n.d.) “Commodity markets.” <https://www.worldbank.org/commodities>

²¹ In an alternative model with quarterly indicator variables, the quarterly indicators were not statistically significant at the 5% level.

16. The model can also be used to examine how productivity-adjusted nominal wages and prices respond to an external shock, such as an increase in commodity prices. To this end, **Table 5** shows the one- and two-year cumulative dynamic multiplier functions for the effects of changes in the log World Bank agriculture commodity price index on log prices and log unit labour costs. The effects are elasticities, so, for example, a 10% increase in agriculture prices is expected to lead to a 0.56% increase in the CCPI one year later and a 1.02% increase in the CCPI two years later. It can be seen that agriculture prices affect the CCPI more strongly at first; after one year, the effect on the CCPI is statistically significant while the effect on unit labour costs is not. After two years, however, there is more noticeable convergence as the effects on both variables are statistically significant and closer together in magnitude. Thus prices tend to respond to external shocks more quickly, while unit labour costs catch up later.

Table 5: Dynamic Multiplier Functions for Changes in Agriculture Prices*

Endogenous Variable	Time	Cumulative Effect	95% Confidence Interval
CCPI	1 year	0.056**	(0.016, 0.096)
	2 years	0.102**	(0.028, 0.176)
Unit Labour Cost	1 year	0.033	(-0.007, 0.074)
	2 years	0.093**	(0.008, 0.178)

Notes (*): Variables are in natural logarithms.

(**): The null hypothesis that the cumulative effect is zero is rejected at the 5% level.

V. CONCLUSIONS

17. Since labour in an economy is ultimately compensated in real terms, wages and consumer prices are inherently linked. In Hong Kong, over the long term, productivity-adjusted nominal wages, or unit labour costs, track consumer prices just as economic theory would predict. Moreover, productivity gains have multiplied real wages by 2.5 times between 1984 and 2021. Yet, in the short or even medium term, unit labour costs and consumer prices respond differently to external shocks and the adjustment process to both the shocks and each other takes time. In Hong Kong, as in other places, consumer prices tend to respond to external shocks first, while unit labour costs follow later. Consequently, over the past few decades, consumer prices have been a leading indicator of productivity-adjusted nominal wages, with little evidence of a wage-price spiral.