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NEW EVIDENCE ON LONG SWINGS***

by

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SUMMARY

This study examines the existence of long swings using long time-series from 12 countries. The analyses, which are made both in the time and the frequency domain, find very little evidence on long swings in output. Instead, there are some signs of long swings in consumer prices.

1. INTRODUCTION

The existence of long swings is a question which constantly challenges economists and economic historians alike. Even though there exists a number of empirical studies addressing this question, no clear and indisputable conclusion has so far been reached (see e.g. Metz (1984) and the references cited there). Obviously, there are various reasons for this lack of agreement but surely one reason is the way in which the empirical analyses have been carried out (i.e. whether or not spectral analysis is used, how the time series are made stationary, and how the spectral densities are computed).

However, it is also evident that the data base used in empirical analyses has not allowed very powerful tests. This is because practically all analyses make use of data from the U.K. and the U.S.A. (and in some cases also from Canada and Sweden). Although the quality of these data is probably better than the quality of other data, one should not simply exclude the possibility of making use of data from other countries. This point becomes all the more relevant when one takes into account the fact that currently there are long times series available on at least the Gross Domestic Product (GDP) and the Consumer Price Index (CPI) for more than 10 countries (see Maddison (1977, 1982) for an extensive data source).[1)]

Hence it seems well-founded to study the existence of long swings with a more extensive data base (at the same time concentrating on genuine economic indicators). This is, in fact, done in this study by using annual data for GDP and CPI from 12 countries. A typical sample period is 1860-1984, which allows for analyses both in the time and frequency domain. These 12 countries (which are listed in Table 1) represent the maximum number of countries which provide long time series for these two variables. The article is organized as follows: first, we examine the time series properties of these series by utilizing the autocorrelation functions (and the corresponding portmanteau tests) as well as the "random walk" tests (proposed particularly by Dickey and Fuller; see e.g. Fuller (1976)

and Dickey and Fuller (1981)). Secondly, we scrutinize the spectral densities and coherencies of these two variables using various alternative spectral windows and data transformations.

2. EMPIRICAL EVIDENCE

As stated above this study makes use of annual data from 12 countries, a typical sample period being 1860-1984. The main data sources are Maddison (1982) and the IFS. A complete description of the data and the data sources as well as a printout of the data is available from the authors upon request. All analyses have been carried out using both nonmanipulated data and data which have been adjusted with dummy variables for the periods of the World Wars. Because this adjustment changed the results only marginally (this is true both for the analyses in the time and frequency domain) we report here only the results obtained with unadjusted data.[2)3)]

We start by testing whether the time series of GDP and CPI are indeed a random walk. To do that we compute the sample autocorrelations for these series, or to be more precise for the log differences of these series. Table 1 reports the corresponding Ljung-Box (1978) test statistics in the case of 35 lags. In addition, Table 1 reports the values of the Dickey-Fuller tau-statistics and the accompanying F-statistics for the higher-order lagged terms, (see Altonji and Ashenfelter (1980) and Fuller (1976) for details). Notice that the random walk tests we carry out here are in fact too strong from the point of view of testing the long swings because now we not only test for the existence of long swings but also for existence of all other types of cyclical movements in these two time series.

Table 1. Results of the Tests for the Random Walk Property

Country	Q:GDP	Q:CPI	tau:GDP	tau:CPI	F:GDP	F:CPI	First year in the sample (GDP/CPI)
Australia	43.44	156.20	2.04	.58	2.76	10.39	1861/1870
Canada	55.15	71.80	2.19	.41	.83	5.10	1870/1910
Denmark	38.50	99.30	2.18	1.18	1.14	11.92	1820/1870
Finland	41.89	140.96	1.36	2.91	4.06	21.25	1860/1870
France	56.32	204.06	1.37	2.18	3.78	19.80	1820/1870
Germany	48.83	..	2.42	..	4.56	..	1850
Italy	42.39	228.91	1.45	2.35	2.10	29.32	1861/1870
Netherlands	25.14	99.33	1.95	1.64	1.77	8.05	1900/1900
Norway	38.54	107.91	1.37	1.82	1.15	21.81	1865/1870
Sweden	36.39	92.97	2.29	.61	1.79	26.88	1861/1870
U.K.	85.94	146.36	2.11	.66	7.14	14.68	1830/1870
U.S.A.	37.80	135.76	3.07	1.13	2.94	22.12	1870/1870

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Q denotes the Ljung-Box test statistic for the log differences of the GDP and CPI series (the number of lags is 35, which implies the following critical values for Q: 49.5 (5 per cent level of significance) and 56.2 (1 per cent level of significance). The Dickey-Fuller tau-statistics are computed by using the equation $\Delta x = a0 + a1x(-1) + a2t + a3\Delta x(-1) + a4\Delta x(-2) + a5\Delta x(-3) + a6\Delta x(-4) + u$, where Δ denotes the backwards first difference operator, t the time trend and u the error term. The F-statistics correspond to the restriction a3 = a4 = a5 = a6 = 0. The approximate critical values of the tau-statistic are 3.45 and 4.04. The corresponding critical values of the F-statistics in the case of 4,125 degrees of freedom are 2.44 and 3.47.

The test statistics rather clearly indicate that GDP more or less follows a random walk process while CPI cannot be characterized by the random walk property. As far as GDP is concerned, there are some minor differences between the results of the Ljung-Box statistics and the Dickey-Fuller tau-statistics cum the F-statistics for the higher-order lagged terms. Thus, the former statistics point to the rejection of the random walk property slightly more often than the Dickey-Fuller tau and F-statistics (Notice here, however, that the power of the Box-Pierce-type statistics is not very high in the sample sizes used in our analyses; see Davis, Triggs and Newbold (1977) for details.)

Nevertheless, we conclude that the GDP series are so close to a random walk that one can really question the existence of systematic cyclical behavior.[4] This implies that the existence of long swings can also be questioned. And the questioning becomes particularly relevant when we take into account the evidence from the spectral densities. This evidence does, in fact, suggest that, if there are any cyclical movements in the GDP series, these movements cannot be characterized by the standard features of long swings.

If one concentrates on the question of the existence of long swings, the use of spectral analysis becomes relevant. In this connection we have thoroughly analyzed the GDP and CPI series by using various alternative lag lengths and windows.[5] Below, we report the results using the Parzen window with a maximum lag of 35. The corresponding spectral densities are shown in Figure 1 for GDP and in Figure 2 for CPI. Finally, the cross-country averages of these measures (with equal weights for all countries) are presented in Table 3. In addition to the averages of the spectral densities, Figure 3 also illustrates the (cross-country average of the) coherency between GDP and CPI.[6]

Now, if these three figures are scrutinized the following conclusions can readily be drawn:

First, there is very little evidence of long swings in terms of GDP. One can almost say that the corresponding spectral densities lend support to the random walk property of these series. It is true that there are some minor exceptions (the U.K. and U.S.A., and to some extent France and Germany). The important point is, however, that the duration of possible long cycles, even in these countries, is less than 15 years. If there are any cycles in the data they are more likely to be "standard business cycles". Thus, one cannot really argue in support of long swings (especially if one takes into account the results of the tests in the time domain).

Secondly, consumer prices do seem to follow a pattern which could be characterized by long swings. Obviously, this is not necessarily

very surprising given some casual observations of the nature and timing of past inflation and deflation periods.[7)]

Finally, total output and prices do not seem to be significantly correlated. This seems to be true with respect to all frequencies. In particular, it cannot be shown that possible long swings in prices are related to corresponding movements in output.

3. CONCLUSIONS

This study has found very little evidence on long swings in output for the 12 countries which were examined. This finding appears to be rather robust in terms of the analyses both in the time and frequency domain. Thus, tests in the time domain indicate that GDP is almost a random walk while spectral analysis suggests that the cyclical movements which can be detected from data do not correspond to long-swings. In contrast to the evidence with respect to GDP, there appear to be some signs of long swings in consumer prices. However, the properties of the price series can be easily explained without referring to some economic model of long swings. All in all, the analyses of both total output and consumer prices suggest that the evidence in support of long swings is very weak and this evidence is probably produced by some specific historical episodes which have no direct economic interpretation.

FOOTNOTES

1) We do not discuss here various alternative explanations of long swings. Clearly, disagreement about the possible explanation(s) makes it difficult to arrange a very powerful test for the whole phenomenon. See Van Duijn (1977) for a thorough survey on the relevant literature.

2) The difference between adjusted and unadjusted data turned out to be so small that most of the test statistics differed only by one or two decimals.

3) Of course, the World Wars are not the only wars which have taken place during the period 1860-1984. While one may agree that the effects of these wars should be eliminated from the

data, it is not clear how to proceed with the other wars, particularly if one accepts the argument that wars are themselves a major causal factor in the process of long swings (see Van Duijn (1977) for further discussion). We preferred not to distort the data with some additional war dummies or with other related data transformations, partly because the WW1 and WW2 dummies did not make any noticeable difference to the results.

4) Notice that here we have used differencing in order to make the series stationary. This is motivated by observation of Nelson and Kang (1981, 1984) according to which eliminating a deterministic time trend tends to produce pseudo-cyclical variations in the data. This was also found to be true in our case. When deviations from linear trend were used instead of log differences, all series had a clear peak at the zero frequency. Also, the Ljung-Box statistics clearly rejected the hypothesis of no temporal correlation.

5) More precisely we have used the following windows: Parzen, a modified Parzen, Tukey-Hamming and Tukey-Hanning (see Priestley (1981) for details). The results with the alternative windows and lag lengths were so similar that we did not consider it necessary to report all of them here.

6) The frequencies have been computed in the standard way so that $f = i/2M$, $i = 0, 1, 2, \ldots, M$, where M is the maximum lag (35). Thus, for instance, the lowest nonzero frequency corresponds to the cycle of 70 years.

7) An obvious causal candidate for the existence of long swings in prices is war. Wars are typically characterized by price and wage controls as well as monetary expansions needed to finance war-time deficits. Moreover, if one takes into account the magnitude of these deficits and the stickiness of prices and wages the observed pattern of price movements can be explained fairly easily.

Figure 1. SPECTRAL DENSITIES OF GROSS DOMESTIC PRODUCT

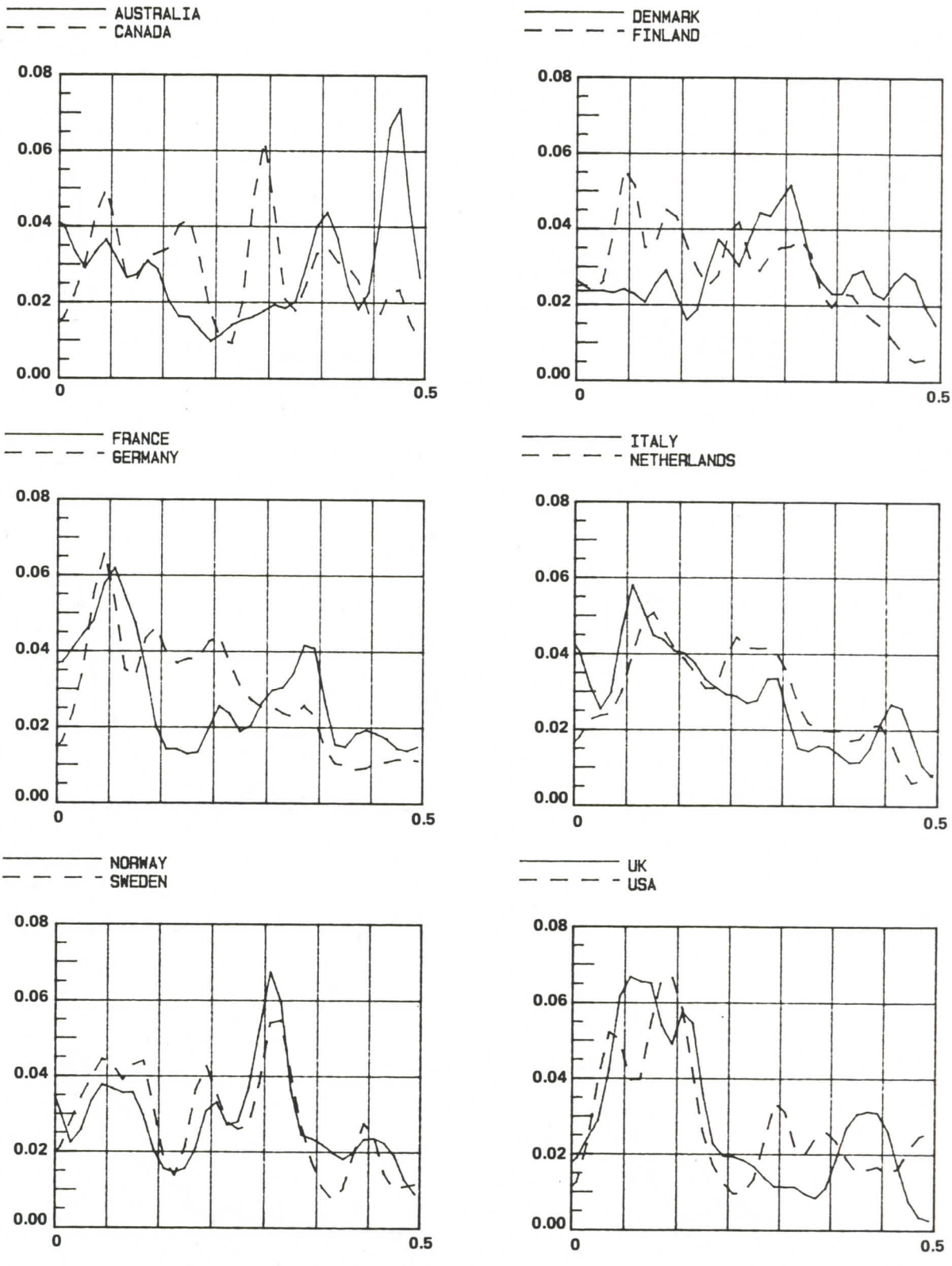


Figure 2. SPECTRAL DENSITIES OF CONSUMER PRICES

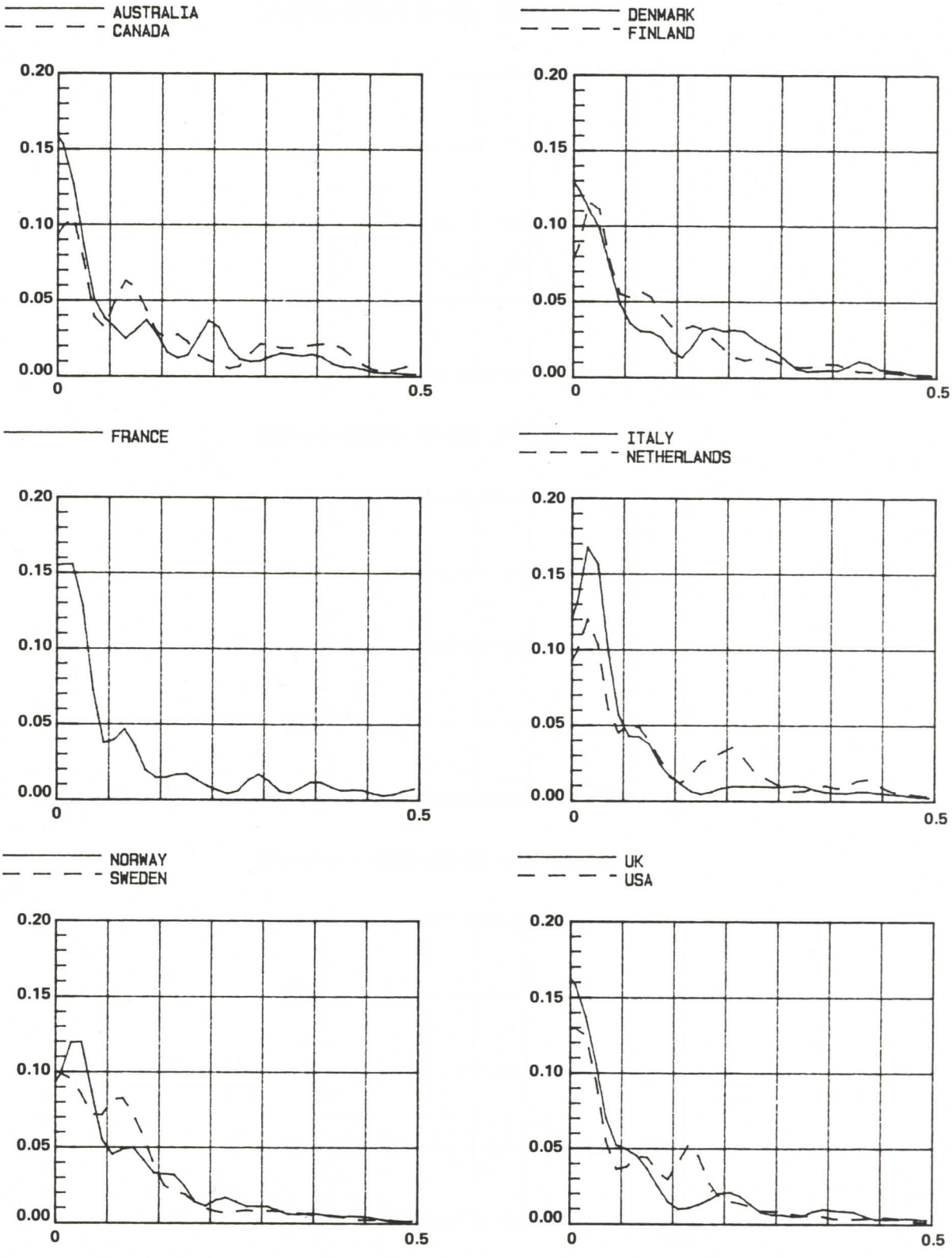
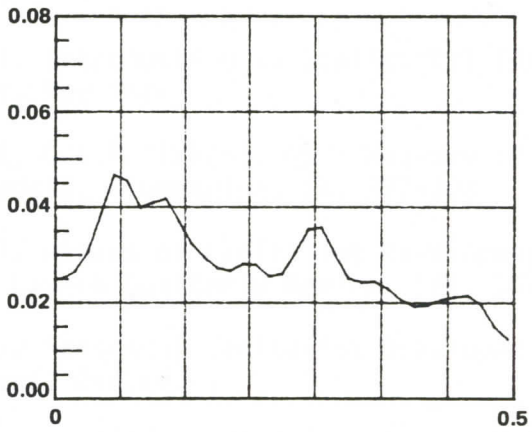
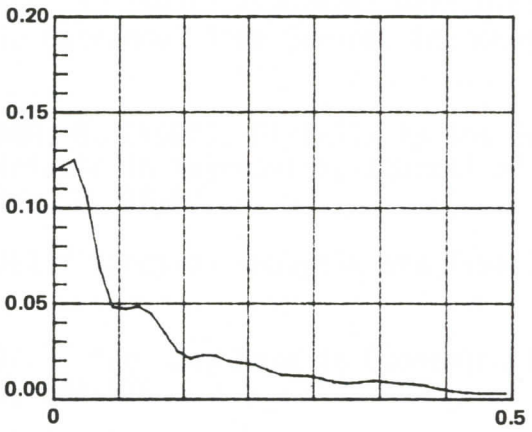


Figure 3. AVERAGE SPECTRAL DENSITIES AND COHERENCE OF GDP AND CPI

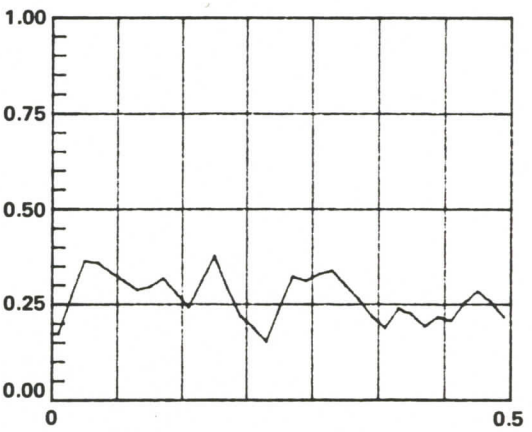
SPECTRAL DENSITY OF GDP, AVERAGE



SPECTRAL DENSITY OF CPI, AVERAGE



COHERENCE BETWEEN GDP AND CPI, AVERAGE



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