Short-Run Deviations From Purchasing Power Parity (PPP): A Case of Expectational Changes

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Abstract

The theory of purchasing power parity was originally designed by Gustav Cassel in 1918 to make the simplified guess of two currencies' exchange rate levels. The theory had a simple but convincing argument that the exchange rates tend to gravitate towards the ratio of purchasing powers of two currencies. However, the actual exchange rates can deviate from these expected values of purchasing power ratios. Recognizing the difference between nominal and real exchange rates, economic theoreticians have tried to compromise these deviations from the actual exchange rates and those expected by the PPP theory. In this paper we hypothesize another explanation for deviations of exchange rates from those values that are expected by the PPP theory. When tested for the selected currencies, our explanation is suitable enough to maintain that the expected PPP for the U.S. and Canadian dollar rate and the U.S. dollar and German mark rate.

Introduction

As is well known, Purchasing Power Parity (PPP) theory states that exchange rates adjust over time so as to offset divergent movement in national price levels. This implies that a country that runs an inflation higher than its trading partner(s) will see its currency depreciating. Originally put forth by Cassel (1918), this theory was initially proved to be capable of explaining exchange rate movements. Officer (1976) provides a detailed description of the development of the PPP theory over the years and the empirical work undertaken to test the theory.

In general, there is a consensus that the PPP theory is valid when a sufficiently long time interval is considered. But at the same time, it is stressed that the concept is relevant only in the long-run, so that deviations from parity may be the rule in the short-run. While fundamental economic variables and behavior such as substitution in demand would ensure the "law of one price" in the long-run, at any given point in time, other factors such as speculative activity could cause such deviations from PPP. The presence of non-traded goods and services has also been pointed out as a cause of deviations from PPP. Efforts have also been made to establish that deviations from PPP form a random walk, with no tendency for reversion to parity.[1]

This paper is devoted to two tasks, both undertaken for the Canadian Dollar-US Dollar exchange rate, the Deutsche Mark (DM)-US Dollar Rate and the US Dollar-Pound rate, with quarterly data for the period from 1974-1988.

First, deviations from PPP in the short-run are modeled as forming a dynamic adjustment mechanism towards a long-run equilibrium where PPP holds. To do this, the error-correction approach popularized in the study of consumption behavior by Davidson, Hendry, Srba, and Yeo (1978) is adopted.[2] It is examined whether short-term PPP exists at all, and the long-run equilibrium solutions are discussed. Second, a possible cause for deviations from PPP in the short-run is put forward and examined for applicability to the exchange rates under consideration. The argument tested here is whether PPP holds with respect to expected, rather than actual, current prices, in which case short-run PPP, in the conventional sense, with respect to current prices, will not hold.[3]

The rest of the paper is organized as follows. Section II derives the equations incorporating an error-correction mechanism for adjustment to long-run PPP and estimates them. Section III is devoted to the examination of the expected PPP theory, while Section IV gathers together the conclusions in a concise fashion.

Short-Run Adjustment and Long-Run Equilibrium

Several earlier attempts to test the evidence of PPP have been undertaken. Broadberry (1987) uses the data of 1930s to test the Pound-Dollar fluctuations. As mentioned

before, Officer (1976) carries out an extensive survey of numerous studies of PPP. However, a clear-cut distinction between absolute and relative versions of PPP is rarely witnessed. Further, the present study uses three different exchange rates and concentrates on the data of 1980s.

We construct the theoretical model in the following fashion. Let E_t represent the relevant exchange rate at period t and RP_t the relevant relative price at period t. Starting with the relation:

(1) $E_t = a_0 + a_1 E_{t-1} + a_2 PR_t + a_3 PR_{t-1}$,

rewrite (1) as

(2) $DE_t = a_0 + a_2 DPR_t - (1-a_1) E_{t-1} + (a_2 + a_3) PR_{t-1}$,

where $DE_t = E_t - E_{t-1}$ etc.

(2) may be further transformed to get

(3) $DE_t = a_0 + a_2 DPR_t - (1-a_1) (E_{t-1} - PR_{t-1}) + (a_2 + a_3 + a_1 - 1) PR_{t-1}$

Then we get the error correction formulation assuming that $a_1 + a_2 + a_3 = 1$, so that the last term in (3) disappears, which implies that the difference between E and Pr, in the log form is constant in the long-run. So the error correction formulation which we use is:

(4) $DE_t = a_0 + a_2 DPR_t - (1-a_1) (E_{t-2} - PR_{t-2})$

As can be seen in (4), the previous errors influence the movement towards the long-run equilibrium, which is given by putting DR=DPR=0. This means in the steady state, E and PR are unchanged.

(5) $E_t = PR_t * a_0/(1-a_1)$

(we could derive the error correction form of equation (4) by starting from the long-run solution of equation (5), and assuming a general lag structure.)

Based on equation (4), the following equations were estimated, but by using the log form (t-statistics are presented in parentheses):

Canadian Dollar-US Dollar rate:

(6) D log CANDOL = 1.145 * D Log USCWP
(-3.87)
-0.048 [Log CANDOL(-1) - Log USCWP(-1)] + 0.0062
(-2.42) (1.27)

$R^2 = 0.36$ F = 20.0

where 'D' refers to difference, CANDOL is the Canadian Dollar-US Dollar exchange rate, and USCWP is the ratio of the U.S. wholesale price index to the Canadian wholesale price index. The data used in our analysis are compiled from the various issues of International Financial Statistics published by the International Monetary Fund. We concentrated on quarterly data alone.

Deutsche Mark-Dollar rate:

(7) D Log DMDOL = -1.4661 D Log USGWP
(-1.183)
-0.0755 [Log DMDOL(-1) - Log USGWP(-1)] + 0.0615
(-1.44) (1.43)

$R^2 = 0.02$ F = 1.2J

where DMDOL is the 1)Deutsche Mark-Dollar rate and USGWP is the ratio of the U.S. to the German wholesale price index.

(8) D Log DMDOL = -2.198 D Log USGWP
(-1.57)
-0.623 [Log DMDOL(-1) + Log USGWP(-1)] + 0.509 D Log
(-2.52) (2.098)
DMDOL(-1) + 0.137T - 0.180
(2.02) (-1.12)

R2 = 0.294 F = 3.29

Pound-Dollar rate:

(9) D Log PDDOL = -0.4525 D Log KSWP
(-0.48)
-0.0783 [Log PDDOL(-1) - Log KSWP(-1)] + 0.041
(-2.2) (1.65)

R2 = 0.08 F = 2.4

where PDDOL is the Dollar-Pound rate and KSWP is the ratio of the UK to the US wholesale price index.

(10) D Log PDDOL = -0.189 D Log KSWP
(-0.12)
-0.5298 [Log PDDOL(-1)- Log KSWP(-1)] + 0.576 D Log PDDOL(1)
(-2.67) (2.649)
-0.0212T + 1.459
(-2.475) (2.49)

R2 = 0.11 F = 2.38

When looking at the estimates in (6) - (11), we will be concerned mainly with the short-run adjustment mechanism and (or) the possibility of short-run homogeneity of the exchange rate with respect to relative prices. By assumption there is homogeneity in the long-run; the assumption that a1 + a2 a3 = 1 in equation (3) amounts to that.[4] Also, for instance, if Log USCWP(-1), the lagged relative price is added, it is not significant, which supports the assumption of long-run homogeneity.

For short-run homogeneity of the exchange rule with respect to the relative price, the coefficient of the change (difference) in relative price should be -1. In equation (6) for the Canadian Dollar-US Dollar rate, the coefficient of D Log USCWP is close to - 1, and significant, so that the hypotheses is short-run homogeneity cannot be clearly rejected. The coefficient of the error- correction is also significant. The long-run solution is obtained by putting the "difference" terms equal to zero; and we get:

(11) Log (CANDOL/USCWP) = 0.002/0.048

i.e., CANDOL = 1.347 USCWP.

Equations (7) and (8) refer to the DM-Dollar rate. In both equations, the coefficient of D log USGWP, the relative price change term, is not close to negative unity. The general fit for the estimated coefficients is a little better in equation (8), after the addition of a lagged exchange rate change term and the time trend (T). In any case, there is no short-run homogeneity with respect to the change in relative price levels. The short-run adjustment or error correction term is significant, at the 5% level in equation (8). The results of estimation for equations (9) and (10) for the Dollar-Pound rate are quite poor. But the error correction terms are significant at the 5% level. The coefficients of Log KSWP are quite different from -1, so that short-run homogeneity of the exchange rate with respect to relative prices cannot be maintained (though the insignificance of these coefficients make any such hypothesis irrelevant).

Equations (6)-(10) were also re-run with consumer price indices instead of wholesale price indices. But the results were, in general, considerably weaker, therefore those results are not reported here.

Expected Purchasing Power Parity

In this section, the contention that PPP holds with respect to expected, rather than actual, price levels (which also constitutes an explanation for deviations from PPP in the conventional sense) is examined. An implicit assumption is, as in the currency- substitution literature,[5] that domestic currency and foreign currency are not perfect substitutes. Hence, when expected rates of inflation differ between countries, holders of real balances will make changes in their composition of real balances (which includes domestic as well as foreign currency), influencing the exchange rate.

To carry out the estimation, forecasts were made for wholesale and consumer price indices, for the period 1974-1988. The method of distributed lags was used; in most cases a log of three quarters was seen to give the best forecasts.[6]

Tests were carried out for absolute as well as relative (expected) PPP,[7] and the periods of 1976-1988 and 1980-1988. The estimated equations are presented below:

Canadian Dollar-US Dollar rate:

(13) Log CANDOL = -0.7437 Log USCWPF + 0.2602
(-6.77) (36.2)

R2 = 0.562 F = 45.8 Period 1980-88

where USCWPF is the forecast for the ratio US wholesale price/Canadian wholesale price.

(14) Log CANDOL = -0.966 Log USCWPF + 1.038 Log CANDOL(-1)
(-2.97) (14.8)

+ 1.096 Log USCWPF(-1) - 0.016
(3.6) (-0.83)

R2 = 0.949 F = 212.9 Period 1980-88

(15) Log CANDOL = -1.2545 Log USCWPF + 0.2637
(-13.41) (07.95)

R2 = 0.762 F = 179.84 Period 1974-88

(16) Log CANDOL = -0.9816 Log USCCPF + 0.2512
(-5.72) (34.1)

R2 = 0.471 F = 32.72 Period 1980-88

where USCCPF is the ratio of the forecast for the US consumer price index to the forecast of the Canadian consumer price index.

Deutsche Mark-US Dollar rate:

(17) Log DMDOL = -6.256 Log USGWPF + 0.9941(-5.92) (25.59)

R2 = 0.494F = 35.16 Period 1980-99

where USGWPF is the forecast of the US wholesale price index divided by the forecast for the German wholesale price index.

Pound-US Dollar rate:

(18) Log PDDOL = -0.901 Log KSWPF + 0.4585
(-3.64) (15.27)

R2 = 0.26 F = 13.2 Period 1980-88

where KSWPF is the forecast for UK wholesale index divided by the forecast for the US wholesale price index.

(19) Log PDDOL = -0.699 Log KSWPF + 0.464
(-6.26) (18.51)

R2 = 0.406 F = 39.2 Period 1976-88

Relative PPP versions:

(20) D Log CANDOL = -0.925 D Log USCWPF
(-3.35)

R2 = 0.27 F = 12.57 Period 1980-88

(21) D Log CANDOL = -1.1032 D Log USCWPF
(-4.13)

R2 = 0.20 F = 13.79 Period 1976-88

Of these equations, (13)-(19) test the relative version of (expected) PPP while the last two deal with the absolute version. For expected PPP to prevail, the coefficient of the expected relative price term in these equations should be -1.

In equation (13), which is for the Canadian Dollar-US Dollar rate for 1980-1988, the coefficient of Log USCW-PF is not close to negative unity. On adding lagged terms for the dependent and independent variable, this coefficient become nearly -1. The overall explanatory power of the equation also improves considerably. So the hypothesis of expected absolute PPP for the Canadian Dollar-US Dollar rate for the eighties cannot be rejected (the t-statistics within the parentheses are also significant at the 5% level). Re-running the equation for the period 1976-1988 hikes up the coefficient of the expected relative price term away from negative unity (see equation (15)). Equations (13)-(15) were run using forecasts for wholesale prices. Equation (16) is an equation using forecasts for consumer prices. Again, the coefficient of two "expected" relative consumer price terms is almost -1, implying the validity of expected PPP.

For the DM-Dollar rate, the coefficient of the expected relative price term in (17) is far from -1, so that expected PPP is rejected firmly for the 1980s. The test failed even more disastrously when using forecasts for consumer prices, and allow for the period 1976- 1988. Those results are not presented here.

For the Dollar-Pound rate, the coefficient of the expected relative wholesale price term is close to -1 in equation (18) - for 1980-1988. So the hypothesis of expected PPP may be maintained for the eighties. It is less evident in (19) for the period 1976-1988. The tests with forecasted consumer prices were not satisfactory.

The equations for relative PPP are presented only for the Canadian Dollar-US Dollar rate; the tests were singularly unsuccessful for the DM-Dollar and Dollar-Pound rates. Also, only results using forecasted wholesale prices are presented since the equations obtained using forecasted consumer prices were unsatisfactory. However, in both equations (20) and (21), the coefficient or the (change in) expected relative price term is fairly close to negative one and significant. So expected PPP cannot be rejected as far as the Canadian Dollar-US Dollar exchange rate in the eighties is concerned.

Conclusion

While there has been no voice raised in the profession against the importance of the notion of Purchasing Power Parity as an equilibrium theory, there is much less consensus regarding the time horizon in which it is relevant. There is a view that as a long- run equilibrium theory, PPP would be irrelevant during a short time interval. One way to get over this difficulty with defining the time interval is to delineate a path or adjustment process towards a long-run equilibrium with PPP. This is done in this paper by specifying an error correction mechanism where adjustment towards the long-run equilibrium depends on past discrepancies in PPP. The analysis is undertaken for three Dollar exchange rates for the eighties. The specification allows us to test for short-run homogeneity of the exchange rate with respect to relative prices (short-run PPP) and also to solve the long-run static equilibrium solution. The analysis was conducted using wholesale prices as well as consumer price indices.

It was found that short-run PPP in the eighties is a defendable proposition only for the Canadian Dollar-US Dollar exchange rate, and that too, with respect to wholesale prices. No short-run homogeneity with respect to relative prices was exhibited by the DM-Dollar and Dollar-Pound exchange rates. However, in all cases, the coefficients of the dynamic adjustment or error correction terms were significant.

The present paper also turns a searchlight on a possible cause for deviations from PPP, namely that PPP holds with respect to expected, rather than actual, current prices. The argument is that when possibilities for currency substitution exist, there will be re-grouping of currency portfolios and exchange rate adjustment when expected rates of inflation differ between countries, so that there will be no purchasing power parity with respect to current prices.

To conduct tests for expected PPP, first forecasts were made for (quarterly) wholesale price and consumer price indices for USA, UK, Germany, and Canada for the time period 1976-1988. The forecasts were made by the method of distributed lags, adhering to a lag of 3 quarters most of the time. Using these forecasted or expected prices, both absolute and relative versions of (expected) PPP was tested. It was seen that expected PPP holds, and so can be put forth as an explanation for deviations from current or actual PPP, for the Canadian Dollar-US Dollar rate. This was true for both the absolute and the relative versions, and for experiments with forecasted wholesale as well as consumer price indices. Expected PPP seems to be plausible also for the DM-Dollar rate, with reference to wholesale prices. The tests fail for the Dollar-Pound rate. But the final conclusion must be that expected purchasing power parity is a tenable proposition, worth further attention and research.

Footnotes

[1]see Adler and Lehmann (1983) and Shaprio (1983).

[2]Broadberry (1987) has also considered the short-run adjustment towards a long-run PPP equilibrium for the Pound Sterling exchange rates in the 1930s.

[3]The only paper concerned with such a test seems to be Fortune(1986), who is concerned with the Pound-Dollar rate for the peroid 1973-1980. He includes that expected PPP is a tenable position.

[4]For long-run homogeneity, the coefficients of the lagged exchange rate and relative price terms should be equal, but of opposite sign.

[5]see for instance, Calvo (1986).

[6]i.e., expectations formed 3 quarters ahead provided the best forcasts.

[7]see Officer (1976) for a detailed discussion of absolute, as well as relative, Purchasing Power parity and their measurement.

⁂ References ⁂

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