Absolute Purchasing Power Parity in African Low-income Countries: A Panel Data Analysis

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Abstract. The validity of absolute purchasing power parity (APPP) in African low-income countries is studied. The panel data method is used. Various dimensions are examined. It revealed that APPP holds better within the African countries than between the African countries and the US, holds better in some sub-panels than in the whole panel, and holds better in the post-Bretton Woods system period than in the Bretton Woods system period.

Introduction

As a basic and important theory in the field of international finance, purchasing power parity (PPP) has been extensively tested ([1], [2]). Correspondingly, PPP in African countries is also studied; see [3], [4], [5], [6], [7], and so on. In popular papers such as those listed above, however, price indexes (consumer, producer, and wholesale price indexes) rather than actual price levels are used. Thus, what these papers discuss is relative PPP rather than absolute PPP ([8], [9]). As relative PPP does not imply absolute PPP, the conclusion obtained in relative PPP cannot be applied directly or with certainty to absolute PPP ([8], p. 784). That is, absolute PPP (hereafter APPP) needs to be specially studied. In this paper, we study APPP in African low-income countries, a topic which has never been explored, to the best of our knowledge. Specifically, we use the same econometric method, the panel data, as in [9].

Method and Data

We follow [9] to define the real exchange rate (RER); see Eq. (1), where \( P_i \) is the price level of country \( i \), \( P^* \) is the price level of a foreign country which is used as the base country, \( PPP_i \) (the PPP rate) is \( P_i \) divided by \( P^* \), and the nominal exchange rate \( NER_i \) is expressed as the domestic currency units per foreign currency unit. In this definition, a greater value of \( RER \) represents the local currency’s appreciation against the foreign country.

\[
RER_i = \frac{P_i}{NER_i \times P^*} = \frac{P_i}{PPP_i} = \frac{NER_i}{PPP_i}
\]  

(1)

In this paper, we use a simple regression method based on Eq. (2), where the RER is defined in Eq. (1), log denotes taking the natural logarithm, and \( C \) is a constant. Concretely, we use panel OLS to estimate Eq. (2), and then examine whether the constant, \( C \), is equal to zero. If the constant is equal to zero, we think that the natural logarithm of the RER is equal to zero, the RER is equal to 1, the RER fluctuates around its equilibrium value, and APPP holds. Otherwise, APPP does not hold. To measure whether the constant \( C \) is equal to zero, the usual \( t \)-test is used. Compared with the method used in [8] and [9], the method in this paper is simpler. To perform their method, one must conduct the cointegration test (to examine whether the cointegration relationship exists), the cointegration coefficient estimation (using the FMOLS or DOLS method), and the Wald coefficient restriction test (to examine whether the nominal exchange rate is equal to the PPP rate). However, to perform Eq. (2) proposed in this paper, one only needs to conduct the usual OLS (to estimate the
constant) and the $t$-test (to judge whether the RER is equal to its equilibrium value); the cointegration method is not needed. In addition, it can be easily seen that the two methods are equivalent, as the nominal exchange rate is equal to the PPP rate if and only if the RER is equal to 1.

$$\log(RER_{it}) = c + u_{it} \quad (2)$$

We use the Penn World Table (PWT) 9.0, made by economists at the University of California, Davis and the University of Groningen, to obtain our data. Concretely, the RER is the “Price level of $CGDP^o$ (PPP/XX), price level of USA $GDP^o$ in 2011 = 1” (the variable “$PL_{GDP}^o$” in the database). In analyzing the Balassa–Samuelson effect or the Penn effect, [10] (p. 3175) uses such a variable. In PWT 9.0, each bilateral RER in each year is against the US dollar and is comparable (the US RER in 2011 = 1). Further, a RER between two countries can be easily derived. For African low-income countries, we choose the 10 biggest ones in terms of economy scale, except for Zimbabwe, which has no separate legal tender. They are Burkina Faso, Chad, the Democratic Republic of the Congo (hereafter the Congo), Ethiopia, Madagascar, Mali, Mozambique, Senegal, Tanzania, and Uganda. Finally, because of data availability, the whole periods for all these countries are not consistent. Concretely, the whole period is 1950–2014 for the Congo, Ethiopia, and Uganda, 1959–2014 for Burkina Faso, and 1960–2014 for Madagascar, Mali, Mozambique, Senegal, Chad, and Tanzania, respectively.

Panel Data Analysis

The panel data dimension can give us the information contained in these countries when they are treated as a whole. As both the whole period and the sub-period are analyzed, we divide the sub-period by the Bretton Woods system according to the routine practice (e.g., [11] and [12]). Specifically, we divide the whole period into two sub-periods: the pre-1973 period and the post-1973 period. In relative PPP studies, the US is often the main (or the single) base country. Thus we also first analyze the validity of APPP by treating the US as the base country. The result shows that when the US acts as the base country for the panel that includes all African countries, APPP does not hold in any period at any conventional level. Then we examine the validity of APPP within African countries, and the result is listed in Table 1, where the seven African country panel is obtained by excluding three countries (Chad, Mozambique and Senegal) from the total 10 African country panel.

Why do we examine the seven African country panel? In our other paper that uses a time series method, it is shown that when Ethiopia (the biggest country among the total of 10) acts as the base country and the whole period is considered, APPP does not hold for Mozambique at any conventional level, only holds for Chad and Senegal at the 1% level, but holds for all the other countries at the 10% level. When Tanzania (the second biggest country among the total of 10) acts as the base country, APPP does not hold for Chad, Mozambique, or Senegal. That is, the validity of APPP is seemingly the worst for these three countries. Thus, we also examine, besides the total 10 country panel, the seven country panel where the three countries are excluded.

Table 1. APPP in the Panel Data Dimension: The 10 African Country Panel and the Seven African Country Panel.

<table>
<thead>
<tr>
<th>Panel</th>
<th>Base country</th>
<th>10 African country panel</th>
<th></th>
<th>Seven African country panel</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Burkina Faso</td>
<td>0.087 (5.429)</td>
<td>0.113 (8.148)</td>
<td>0.078 (4.918)</td>
<td>0.007 (0.444)</td>
<td>-0.030 (1.476)</td>
<td>0.020 (1.193)</td>
<td></td>
</tr>
<tr>
<td>Chad</td>
<td>0.493 (33.072)</td>
<td>0.983 (69.766)</td>
<td>0.326 (21.915)</td>
<td>0.021 (1.440)</td>
<td>0.050 (2.757)</td>
<td>0.008 (0.631)</td>
<td></td>
</tr>
<tr>
<td>Congo</td>
<td>0.097 (6.417)</td>
<td>0.174 (13.399)</td>
<td>0.067 (4.735)</td>
<td>0.005 (1.440)</td>
<td>0.050 (2.757)</td>
<td>0.008 (0.631)</td>
<td></td>
</tr>
</tbody>
</table>

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Notes: The above value without parentheses is the coefficient, the middle value in parentheses is the t-statistic, and the bottom value in parentheses is the p-value. The fixed effects estimation is used, which is justified by the redundant fixed effects test. The panel unit root test indicates that most of the RERs are stationary.

We can see that, in the 10 country panel, APPP holds for the sub-period 1974–2014 at the 10% level when Madagascar and Mali act as the base countries, and for the whole period at the 1% level when Uganda acts as the base country. For the remaining periods, no matter which country acts as the base country, APPP does not hold at any conventional level.

In the seven country panel, APPP holds for 13 periods (e.g., all the periods when Burkina Faso acts as the base country), and does not hold for eight periods (e.g., the 1950–1973 and 1974–2014 periods when Ethiopia acts as the base country). That is, the validity of APPP in the seven country panel is improved compared with the 10 country panel.

When the two sub-periods are compared, it seems that APPP holds better in 1974–2014 (the post-Bretton Woods system period) than in 1950–2014 (the Bretton Woods system period), as APPP only holds in the former sub-period for Mali in the 10 country panel and for the Congo in the seven country panel at the 0.05 level, but does not hold in the latter period for the two countries in the same cases; however, the results for Madagascar in the two panels are inconsistent.

In addition, we have also examined a nine country panel (the total of 10 countries excluding Mozambique) and a eight country panel (the total of 10 countries excluding Mozambique and Senegal). (1) In the nine country panel, APPP holds for nine (out of the total 27) periods at the 1% level. In the eight country panel, APPP holds for seven (out of the total 24) periods. Thus, compared with the whole country panel in Table 1 where APPP only holds for three periods, the validity of APPP in the two sub-panels is also improved. (2) Except the inconclusive cases, APPP holds for Burkina Faso in its sub-period 1974–2014 but not in its sub-period 1950–1973 in the nine and eight country panels, and holds for Tanzania in its sub-period 1974–2014 but not in its sub-period 1950–1973 in the eight country panel. This also indicates the greater validity of APPP in the post-Bretton Woods system period, as shown in Table 1.

Conclusion

In relative PPP studies, economists have conducted thorough research about African countries. However, how APPP behaves for African countries is still scarcely addressed. Thus in this paper we investigate APPP for 10 typical African low-income countries. It is revealed that when the US acts
as the base country, APPP does not hold. However, APPP does sometimes hold for the panels when an African low-income country acts as the base country. Within the African countries, in addition, APPP is shown to hold better in some sub-panels than in the whole panel, and holds better in the post-Bretton Woods system period than in the Bretton Woods system period. These findings add new knowledge for us to understand the APPP theory in the real world.

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References