TESTING PURCHASING POWER PARITY HYPOTHESIS FOR TURKISH ECONOMY

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Abstract:

The aim of this study is to test purchasing power parity hypothesis empirically by using cointegration method. For this reason, monthly data for six major countries' exchange rates and price levels that cover the period between 1982-1997 are employed. This period represents the managed floating exchange rate regime, and since 1989 relatively more floating exchange rate regime. The cointegration test results indicate that PPP does not hold for the period between 1982-1997. Nevertheless, for the period between 1989-1997 we found a weak cointegrating relationship between the two out of six pairs of series. These pairs of series are Italian Lira relative price and British Pound relative price series.

Özet:

SATINALMA GÜCÜ PARİTESİ HİPOTEZİNİN TÜRKİYE EKONOMİSİ İÇİN TEST EDİLMESİ

Bu çalışmada satınalma gücü paritesi (SAGP) hipotezi eşbütünleşme yöntemi kullanılarak ampirik olarak test edilmektedir. Bu amaçla altı ülkeye ait 1982-1997 dönemini kapsayan aylık döviz kuru ve fiyat düzeyi verileri kullanılmıştır. İncelenen dönem, konrollü dalgalı kambiyo rejimini ve 1989'dan bu yana göreceli olarak daha esnek kambiyo rejimini temsil etmektedir. Eşbütünleşme sınamaları sonucunda, 1982-1997 döneminde SAGP'nin geçerli olmadığı, fakat 1989-1997 dönemi incelendiğinde, altı çift seriden ikisinde zayıf bir eşbütünleşme ilişkisi olduğu ortaya çıkmıştır. Bu seri çiftleri ise İtalyan Lireti ve İngiliz Sterlini'nin göreceli fiyat serileridir.

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Anahtar kelimeler : Satınalma gücü paritesi hipotezi, birim kök testleri, eşbütünleşme.

1. Introduction

One of the most attractive research areas in the economic literature has been the empirical testing for purchasing power parity (PPP) hypothesis of exchange rate determination. During the 1970s and the early 1980s many studies tested the validity of PPP by using classical econometric methods[1], and they found, in general, no supportive evidence for PPP, especially under the floating exchange rate regime era after the 1970s. Since the data on prices and exchange rates are in the form of time series, time series properties of these variables are neglected in the classical approach, which may lead to spurious conclusions. Engle and Granger (1987)'s seminal work on cointegration and the other progress in time series econometrics made possible for economists to test the long run relationships between (or among) variables by taking into account the time series properties. Taylor (1988), Canarella et al (1990), Ahking (1990), Bleaney (1992) and McNown and Wallace (1989,1994) are among others who used the cointegration methods in testing PPP hypothesis.

The purpose of this study is to empirically test the validity of the simple version of PPP in case of Turkish economy, that experiences high inflation and depreciates the currency continuously since the late 1970s, by using cointegration tests. For this reason, six countries among the major trade partners of Turkey are selected. Time series data for these countries' currencies and price levels, being namely the U.S. Dollar, British Pound, German Mark, French Franc, Italian Lira, Japanese Yen, and the price indices of these six countries will be employed in the tests. The monthly exchange rate and price level series cover the period from 1982.01 to 1997.05. The beginning date is especially chosen to represent the policy shift towards managed floating exchange rate regime in Turkey.

The managed floating exchange rate regime in Turkey began in May 1981. In other words, the Central Bank of Turkey started to determine the exchange rate parities on a daily basis. This was a part of the liberalization program launched in 1980. The other progress was made in 1984, in which year Turkish citizens were allowed to have foreign currency denominated accounts within Turkish banks. Nevertheless, the major step toward more flexible exchange rate regime was taken in August 1988. An interbank foreign exchange market was opened within the Central Bank of Turkey, and the exchange rates began to be determined by the participants of The Central Bank, commercial banks and other financial institutions. Further liberalization continued in 1989, when the Turkish Lira was made convertible. Since February 1990, the exchange rates are determined in the interbank foreign exchange market by the banks and financial institutions independent of the Central Bank (Karluk, 1996:509-529).

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[1]For example, Krugman (1978), Frenkel (1981), Hakkio (1984) are a few among others.

In the light of these developments in the exchange rate regime in Turkey, our analysis will consist of two parts. The first part covers the period from 1982.01 to the present (1997.05) to denote the policy shift from the fixed exchange rate system to a managed flexible system. The second period spans the more floating exchange rate regime era starting with 1989.01.

The next section of the paper briefly discusses the purchasing power parity models. In part 3, the data and the methodology are explained, and the data are analyzed for unit root and cointegration. Concluding remarks are made in part 4.

2. The Model for PPP

The simple version of purchasing power parity hypothesis can be expressed as

$$e = p - p^* \tag{1}$$

where e is the logarithm of the exchange rate (domestic price of foreign currency), p is the logarithm of domestic price level and p^* is the logarithm of the foreign price level.

A strict PPP approach would constrain the exchange rate to move exactly in accordance with relative price level, and hence

$$e = PPP \tag{2}$$

In general, to estimate equation (2) the regression model

$$e_t = a + b(PPP)_t + u_t \tag{3}$$

is used. Equation (2) should be viewed as an equilibrium relationship between relative prices and exchange rates, rather than as a theory of exchange rate determination. If an equilibrium relationship between exchange rates and relative prices exists, then the residuals of (3) should be stationary. Many empirical studies have shown that exchange rate and price series are integrated processes (i.e., nonstationary). In order to let an equilibrium relationship between integrated variables to exist, the residuals should prove to be stationary processes. In such a case it is said that the variables are cointegrated. Thus, a cointegration test would reveal whether a long-run relationship between exchange rates and relative prices exists.

To test PPP hypothesis we will use monthly data covering the period from 1982.01 to 1997.05 which means 185 monthly observations for each of the involved series. The theoretical exchange rate in equation (3) is taken as the price

of U.S. Dollar, German Mark, British Pound, French Franc, Italian Lira and Japanese Yen in Turkish Liras. One of the crucial points in testing PPP involves selection of price indices. The theoretical price indices in equation (3) are generally interpreted by PPP proponents as a general price index, which would include the broadest range of commodities. The best-candidate indexes are GDP (or GNP) deflator, wholesale price index (WPI), and consumer price index (CPI). Since GDP (or GNP) deflator is not available monthly or even quarterly for some countries, the most common indexes used in empirical applications are CPIs and WPIs. In this study we use the CPIs of the U.S., Germany, the U.K., France, Italy, Japan and Turkey, due to reasons of availability. In addition, the WPIs of the U.S. , Japan and Turkey are also examined[2].

To test PPP hypothesis, all the exchange rate and the relative price series in logarithms will be detected for a unit root. Then, provided that all the series are integrated, the Engle-Granger cointegration test will be applied to the residuals of (3).

3. Unit Root and Cointegration Tests

The augmented Dickey-Fuller (ADF) test and the Schmidt-Phillips test will be used to detect a unit root in the series. The ADF test is generally criticized for having a low test power. Thus, in addition to the ADF test, we will also use the unit root test developed by Schmidt and Phillips (1992), which is claimed to be more powerful than the ADF test under certain circumstances.

For the ADF test the following, the following formula, which includes an intercept and a linear time trend, will be used.

$$\Delta y_t = \alpha_0 + \alpha_1 t + \alpha_2 y_{t-1} + \sum \beta_i \Delta y_{t-i} + u_t \qquad (4)$$

The null hypothesis of $\alpha_2 = 0$ against $\alpha_2 \neq 0$ will be tested.In other words, the null hypothesis is that the series are integrated of order one, which means thatthe series are nonstationary but the first differences are stationary. In (4), y_t is the natural logarithm of the series, and t is a time trend.

The Schmidt-Phillips test is based on the Lagrange multiplier (LM) test derived from the following data generating process (DGP):

$$y_t = \psi + \xi t + X_t \quad , \quad X_t = \beta X_{t-1} + \varepsilon_t \qquad (5)$$

[2]All the data are obtained through the Internet. The CPIs (1982-1984=100) of the six foreign countries are obtained from the U.S. Bureau of Labor Statistics (stats.bls.gov), Japanese price indexes are obtained from the Bank of Japan (www.boj.go.jp), and the exchange rates and Turkish price indexes are obtained from the Central Bank of Turkey (tcmb.gov.tr).

where the unit root corresponds to $\beta = 1$. The advantage of this DGP is that it allows for trend under both null and alternative hypotheses. The maximum likelihood estimates of the parameters are as follows:

$$\tilde{\xi} = \text{mean}\Delta y = (y_T - y_1)/(T-1) \quad \text{and} \quad \tilde{\psi}_x = y_1 - \tilde{\xi} \tag{6}$$

These estimated parameters are employed in (7) to generate the residuals of

$$\tilde{S}_t = y_t - \tilde{\psi}_x - \tilde{\xi}t \quad , \quad t = 1,....,T. \tag{7}$$

These residuals are then used in the regression

$$\Delta y_t = \delta + \phi \tilde{S}_{t-1} + v_t \quad , \quad (t = 2,....,T) \tag{8}$$

where δ and v_t are an intercept and an error term respectively. If we denote the least square estimates of ϕ by $\tilde{\phi}$ the LM test then becomes

$\tilde{\rho} = T\tilde{\phi}$

$\tilde{\tau}$ = the usual t-statistics for $\phi = 0$ in (8).

The critical values of these test statistics are tabulated by Schmidt and Phillips (1992: 264). The ADF and the Schmidt-Phillips unit root test results for log levels are presented in Table 1 and in Table 2.

Table 1. Unit Root Test Results for the Log of Exchange Rates

	ADF[a]	Schmidt-Phillips
Dollar	-0.899 *(1)*	-0.888
Franc	-2.042 *(1)*	-0.938
Lira	-2.167 *(1)*	-1.323
Mark	-1.917 *(1)*	-1.100
Pound	-1.445 *(9)*	-1.197
Yen	-2.027 *(11)*	-1.594

[a]Numbers in parentheses are the lag orders.

Table 2. Unit Root Test Results for the Log of Relative Prices[a]

	ADF[b]	Schmidt-Phillips
PPP_{US}	-1.289 *(12)*	-0.654
PPP_{FR}	-1.532 *(12)*	-0.598
PPP_{IT}	-1.512 *(12)*	-0.585
PPP_{GE}	-1.384 *(12)*	-0.693
PPP_{UK}	-1.170 *(12)*	-0.624
PPP_{JA}	-1.373 *(12)*	-0.648
$WPPP_{JA}$	-1.304 *(1)*	-0.742
$WPPP_{US}$	-1.209 *(1)*	-0.748

[a]For example, PPP_{US} = log (Turkish CPI / U.S. CPI)
and $WPPP_{JA}$ = log (Turkish WPI / Japanese WPI)
[b]Numbers in parentheses are the lag orders.

All the values are below the critical values, hence it is concluded that all the variables are integrated[3] of order one (I(1)). The lag order for the ADF test is determined by the last statistically significant coefficient on the lagged variables.

Since all the series are found to be I(1), in the next step we will conduct the Engle-Granger (EG) cointegration test for each couple of the series by using regression (3). To test the null hypothesis of no cointegration we will use the following formula

$$e_t = \rho e_{t-1} + \sum_{i=1}^{k} \delta_i \Delta e_{t-i} + \varepsilon_t \quad , \qquad (9)$$

where e_t indicates the estimated residuals obtained from regression (3). Here, null hypothesis is set as $\rho = 1$.

The EG cointegration test is primarily the ADF test based on the residuals generated from regression (3). However, the critical values are not those of Dickey (1976:373), because the EG cointegration test is applied to the estimated residuals of two I(1) series in equation (3), while the ADF test is applied directly to the series. The cointegration test results for two periods[4] are given in Table 3.

Table 3. Cointegration Test Results

Sample Period :	1982.01 - 1997.05	1989.01 - 1997.05

[3] To ensure that the variables are I(1), the first differences are also checked for a unit root, and all the differences were found to be stationary. The data and the results are available on request.
[4]The unit root tests results for the period (1989.01 - 1997.05) indicates also that all the variables are I(1).

	ADF	ADF
Pound - PPP_{UK}	**-3.30*** *(4)*	**-3.43**** *(4)*
Dollar - PPP_{US}	-2.72 *(1)*	-2.93 *(1)*
Lira - PPP_{IT}	-2.46 *(9)*	**-3.51**** *(9)*
Franc - PPP_{FR}	-2.42 *(1)*	-3.05 *(1)*
Mark - PPP_{GE}	-2.55 *(1)*	-2.94 *(1)*
Yen - PPP_{JA}	-2.02 *(3)*	-2.40 *(3)*
Dollar - $WPPP_{US}$	-2.63 *(1)*	-3.03 *(1)*
Yen - $WPPP_{JA}$	-2.68 *(11)*	-2.14 *(11)*

* indicates that cointegration cannot be rejected at 10% significance level

** indicates that cointegration cannot be rejected at 5% significance level

For the sample period that covers 1982.01 - 1997.05 only the Pound-PPP_{UK} series seems to contain a weak cointegration relationship at 10% level. When we consider the other sample period of 1989.01-1997.05, the test results seem to be improved only in two couple of series, namely in Pound-PPP_{UK} and in Lira-PPP_{IT} series. In these series cointegration relationship can be accepted only at 5% significance level.

4. Concluding Remarks

Turkish economy has experienced high inflation rates, and continuously depreciating Turkish Lira since the late 1970s. In such an environment, it is worth to investigate whether a long-run relationship between exchange rates and relative prices exists as stated by PPP hypothesis. In doing this, instead of focusing only on one country, we preferred to use an extensive data set for several countries in implementing the EG cointegration tests. This analysis covers the period from the beginning of controlled flexible exchange rate regime to the present. We also analyzed the subperiod that is thought to be the closest to floating exchange rate regime. The findings of the cointegration analysis can be interpreted as follows:

1. From the beginning of the controlled flexible exchange rate regime to the present (1982.01 - 1997.05) we found no supportive evidence for PPP. The only but weak support is found in the British Pound relative price series. In addition, the WPIs of U.S. and Japan yielded the same sort of results.

2. When we consider the floating exchange rate regime (1989.01 - 1997.05) two out of six couples of series contain cointegration relationship at 5 percent significance level. These series are the British Pound relative price and the Italian Lira relative price series. This result is somewhat interesting when we consider the inflation rates of the six countries. Britain and Italy have the highest inflation rates among the six countries. McNown and Wallace (1989) found that PPP holds better in some countries experiencing high inflation[5]. To the authors, the monetary factors

[5] McNown and Wallace (1989) analyzed the currencies of Argentina, Brazil, Chile and Israel relative to the U.S. Dollar.

in high-inflationary economies dominate inflation and exchange rate changes, hence PPP holds better.

In conclusion, although Turkish economy has experienced high inflation during the sample period in question, PPP hypothesis does not explain properly the depreciation of Turkish Lira against the major foreign currencies. Nevertheless, under more floating exchange rate regime era, we found weak support for PPP, especially for the exchange rates of the countries that have relatively higher inflation rates. Even though we cannot confidently establish that PPP holds better if the corresponding countries have relatively higher inflation rates, it appears that under the more flexible exchange rate regime PPP hypothesis has a tendency to hold.

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