REASSESSMENT OF THE PPP BY ERROR CORRECTION MECHANISM FOR THE TURKISH CASE

A Thesis
Submitted to The Department Of Economics
and the Institute of Economics and Social Sciences
of Bilkent University
In Partial Fulfillment of The Requirements
for The Degree of

MASTER OF ARTS IN ECONOMICS

By

Süheyla Özyıldırım
November , 1990

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tarafından bağışlanmıştır.

I certify that I have read this thesis and in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

Prof. Dr. Sübidey Togan

I certify that I have read this thesis and in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

Assoc. Prof. Dr. Ümit Erol

I certify that I have read this thesis and in my opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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Approved by the Institute of Social and Economics Sciences

Director :

ABSTRACT

REASSESSMENT OF PPP BY ERROR CORRECTION MECHANISM FOR THE TURKISH CASE

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MA in Economics

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In this study, most popular exchange determination policy, PPP has been tested for the long-run equilibrium. For the test of long-run equilibrium, autoregressive distributed lag model is constructed and the model is estimated using cointegration test and error correction frameworks. The present study tests PPP within the time periods January 1980 to December 1989 for the TL/USD and the TL/DM cases separately. The findings of the study suggest that in Turkey, PPP will not hold even in the long-run.

Key words : Purchasing power parity, long-run equilibrium, autoregressive distributed lag model, cointegartion test, error-correction mechanism.

ÖZET

SAP'I HATA DÜZELTME MEKANİZMASI İLE
TÜRKİYE DURUMU AÇAN YENİDEN DEĞERLENDİRME

Süheyla ÖZYILDIRIM
Yüksek Lisans Tezi, İktisat Bölümü
Tez Yöneticisi : Prof. Dr. Sübidey Togan
Kasım 1990, 42 Sayfa

Bu çalışmada son derece popüler döviz kuru belirleme politikası, SAP uzun vade dengesi için test edilmiştir. Uzun vade dengesini test etmek için, otoregresif dağıtıcı gecikmeli model kuruldu ve bu model eşbütünleşme testi ve hata düzeltme çerçevesinde tahmin edildi. Şimdiki çalışma SAP'I, Ocak 1980'den Aralık 1989'a kadarki zaman aralığında TL/USD ve TL/DM durumları için ayrı ayrı test eder. Çalışmanın sonuçları Türkiye'de SAP'ın uzun vadede bile tutmuyacağı hakkında fikir verir.

Anahtar Sözcükler : Satın alma paritesi, uzun vade dengesi, otoregresif dağıtıcı gecikmeli model, eşbütünleşme testi, hata düzeltme mekanizması.

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CONTENT

LIST OF TABLES

1. INTRODUCTION

The purpose of the present study is to examine the theory of purchasing power parity. Although the PPP theory is the most well-known one, this study is mainly an empirical review of the theory.

Most recent studies[1] showed that for many countries and over many time periods which supports the basic PPP hypothesis that tends in relative price levels between two countries are offset by the movements in the exchange rate in the long-run. This conclusion leads to test the theory concerning the validity in the determination of the exchange rate.

The present study aims to analyse in which direction the PPP theory can be amended so that in the long-run, it can be retained as a useful empirical relationship. The study is organized as follows. The second section contains a brief review of some issues of the theory. The first part of the third section outlines the modelling strategy and develops a dynamic model of exchange rates specifically the error correction model and the second part of the third section analyses the regression results. The final section concludes the study.

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1. see Gailliot (1970), Myhrman (1976), Officer (1976)

2. THE PURCHASING POWER PARITY THEORY OF EXCHANGE RATE DETERMINATION

2.1. Historical Background

The purchasing power parity theory is the oldest and simplest theory for determining the exchange rates. In essence, the PPP theory is the explanation of the exchange rate with respect to the ratio of the domestic price levels to the foreign price levels.

The PPP hypothesis is stated as

$$E_t = P_t/P^*_t \qquad (1)$$

where E is the exchange rate (domestic currency value of a unit of foreign currency), P and P^* are index of domestic and foreign prices respectively.

In general, the PPP theory consists of two definitions, namely absolute and relative price parities. However, the theory can be formulated in a variety of ways by using various price measures such as GDP deflator, consumer price levels, wholesale price levels etc.

2.1.1. Absolute PPP Theory

This approach has been originated by Cassel which states that the equilibrium exchange rate will equal the ratio of the countries' price levels as equation (1). The idea behind this version is that; the value of a currency is determined fundamentally by the amount of goods and services that a unit of currency can buy in the country of issue. With this statement, the value of one country's currency relative to the other's is the short-run equilibrium exchange rate.

2.1.2. Relative PPP Theory

Relative PPP is based on the price level changes affecting the exchange rates. According to this approach, the exchange rate variations must compensate the relative increases or decreases of the price levels between two countries. The relative PPP relationship can be formulated as,

$$dE_t/E_t = dP_t/P_t - dP^*_t/P^*_t$$

where dE/E is the percentage change in exchange rate and dP/P and dP^*/P^* are the percentage changes in domestic and foreign price index

respectively.

2.2. Conceptual Background

There are different views on the theoretical underpinnings of PPP relationship. The most common approach is founded on the law of one price.

2.2.1. Law of One Prices

This law states that the domestic price of a certain commodity must be equal to its price in the foreign market when the current exchange rate is used to convert the domestic currency to the foreign currency. It is argued that the law of one price is a necessary condition for the absolute PPP; but not sufficient by itself.[2] If there exists differences in the real prices of a commodity in two countries, then traders will purchase in the cheap markets. This naturally will lead to an increase in demand of that commodity and a more supply in the high price market. Consequently, the arbitrage mechanism will continue until the prices are equalised in both markets.

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2. see Dornbusch (1985)

However, Dornbusch (1985) has argued that if commodities are not strictly identical or if the weights in the price indices being used differ between the two countries, the law of one price does not provide valid basis for PPP.

2.2.2. Criticisms of the PPP theory

The criticisms related to the theory can be mainly summed into two categories; those referring to methodology and those referring to accuracy of the theory itself.

The first set of criticisms relates to the question of which price index should be used in computing the parity as an expression of the equilibrium exchange rate. The differences in the consumption basket across countries implies that changes in relative prices will result deviations from PPP. Also, it is natural to have different consumption bundles with different weights in the price level indexes due to economical structure of countries. In that sense the relevancy of indexes become debatable.[3]

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3. see Officer (1976) p.16

The differences in the coverage of indexes and the weighting patterns are generally accepted as one of the causes of poor performance of empirical PPP tests since in such a case real disturbances change relative prices and create equilibrium PPP deviations.

There are two different views in the choice of the price index; one is the use of traded goods price index and the other one is the use of all goods price index. It is generally claimed that non-tradables are irrelevant for exchange rate determinations since they do not enter international arbitrage. So, the use of indices containing traded goods prices in computing the parity leads to a truism.[4]

The second set of criticism emphasises various factors other than the relative prices determine the exchange rates as a major reason why practical application of the PPP will be limited value. These factors are trade restrictions through the use of tariffs, quotas, export controls, etc. Accordingly, the existence of such factors besides giving rise to a deviation of short-run equilibrium exchange rate from the long-run equilibrium exchange rate, may also prevent the former from adhering to

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4. see Frenkel (1981) p.152-154

the latter. It is widely accepted that the existence of these factors reduced the accuracy with which the short-run equilibrium exchange rate tend to absolute PPP especially.[5]

2.2.3. Monetary Disturbances

It is important to note that the interpretation of PPP as a homogeneity postulate[6] applies only the case in which all the disturbances are purely monetary. As long as shocks to the system are of a monetary, PPP will hold in the long-run. According to this view a purely monetary disturbances will lead to an equiproportionate change in money, commodity price and the price of foreign exchange while leaving relative prices in both countries' goods, unchanged. This view also supported empirically by Frenkel (1981).

2.2.4. Pitfalls in Application of PPP

While testing the relevancy of the relative PPP, the base period

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5. see Officer (1976) p.16-18

6. see Edison and Klovland (1987) p.310

should be chosen as the year when the absolute PPP holds for the determination of the exchange rate. Otherwise, changes in the exchange rates may reflect the relative changes of the price levels, although the result does not give the equilibrium exchange rate with respect to the ratio of price indices.

Also, the choice of the country may affect the PPP test results. The empirical studies indicate that compared countries with similar economic policies and with strong trade links favour the PPP approach.

3. EMPIRICAL STUDIES OF PURCHASING POWER PARITY

3.1. Modelling Strategy

A full of theoretical and empirical models of exchange rate behaviour has been built around purchasing power parity (PPP). Conventional tests of PPP, which primarily use two stage least squares and then test coefficient restrictions, find evidence in favour of the empirical validity of the absolute version of PPP.[7] However these tests neglect the fact that the levels of spot exchange rates and domestic and foreign prices are typically nonstationary, which makes the use of standard critical values inappropriate.

In contrast, the present study test whether PPP holds as a "long-run equilibrium" relationship so, the key assumption of the PPP is long-run proportionality between exchange rates and relative price levels.

The general specification of the model is Autoregressive Distributed (AD) lag model having lags on both independent and dependent variables.

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7. see Corbea and Ouliaris (1988) p.508

With reference to simple PPP model, the testable model can take the form;

$$p_t = \beta_0 + \sum_{j=0}^{n} (\beta_j p^*_{t-j} + \beta_j e_{t-j} + a_j p_{t-j-1}) + u_t \qquad (2)$$

where n is the common lag and the error term u_t is white noise.

Once the final lag specification of the model has been chosen, the long-run assumption of purchasing power parity can be analyzed. As stated before, the key assumption of PPP is long-run proportionality between exchange rates and relative price levels. In this study, short run (monthly) data which may be dominated by transitory dynamic adjustments have been used, these data may not be suitable for testing the assumption. So, the way of avoiding such a controversy is either the use of annual data or the specification of the models in a way to represents the dynamic adjustment processes which permit the specification of short-run influences affecting the exchange rate.[8] In this study, the second alternative has been adapted mainly because of the availability of a model called error correction model (ECM), specifically designed to deal with theories which yield long-run

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8. see Edison and Klovland (1987) for the discussion on dynamic modelling of PPP

equilibrium relationships.

If PPP does not hold at a particular moment signifying "disequilibrium", by applying ECM to the model, the domestic price level will adjust to eliminate the discrepancy (error) that exists.

For the simplification of exposition, by dropping the lag terms of (2), the specification of ECM can be easily shown. In logarithmic terms, the simple PPP model (1) has been stated as;

$$p_t = k^* + p^*_t + e_t$$

where k* is any scalar.

For more simplification, let the vector (p^*_t , e_t) called as X' and by rewriting the model;

$$p_t = k^* + X_t \qquad (3)$$

Now, the Autoregressive Distributed model of lag one for each variable can be written as follows;

$$p_t = a_0 + a_1 X_t + a_2 X_{t-1} + b\, p_{t-1} \qquad (4)$$

where a_0 is used instead of k^* for the conformity to other coefficients.

If the long-run proportionality between p_t and X_t implies the steady

state solution where p_t and X_t are growing at the same constant rate through time, we should show that certain restrictions must hold:

$$p_t = a_0 + a_1 X_t + a_2 X_{t-1} + b\, p_{t-1} \qquad (5)$$

$$p_{t-1} = a_0 + a_1 X_{t-1} + a_2 X_{t-2} + b\, p_{t-2} \qquad (6)$$

as both p_t and X_t are growing at the same rate, by subtracting the equation (6) from the equation (5) , the model becomes;

$$\Delta p = a_1 \Delta X + a_2 \Delta X + b\, \Delta p$$

by rearrangement;

$$(1-b)\, \Delta p = (a_1 + a_2)\, \Delta X$$

Thus for proportionality to hold, the restriction;

$$1-b = a_1 + a_2 \quad \text{or} \quad a_1 + a_2 = \beta$$

must be satisfied.

Now, by substituting the restriction into the equation (4), we have

$$p_t = a_0 + (-a_2 + \beta)\, X_t + a_2 X_{t-1} + (1-\beta)\, p_{t-1} \qquad (7)$$

then by adding and subtracting the term βX_{t-1} on the lefthand of (7) and by necessary adjustments;

$$p_t = a_0 + -a_2\, X_t + \beta\, X_t + a_2 X_{t-1} + \beta X_{t-1} - \beta X_{t-1} + (1-\beta)\, p_{t-1}$$

the equation becomes;

$$p_t - p_{t-1} = a_0 + (-a_2 + ß)\ (X_t - X_{t-1}) + ßX_{t-1} - ß\ p_{t-1}$$

or;

$$\Delta p_t = a_0 + a_1 \Delta X_t + (1-b)\ (X_{t-1} - p_{t-1})$$

and in more open form;

$$\Delta p_t = a_0 + a_1 \Delta p^*_t + a_3 \Delta e_t + (1-b)\ (p^* + e - p)_{t-1} + u_t \qquad (8)$$

Thus, when $\Delta p_t = \Delta p^*_t = \Delta e_t = u_t = 0$, the equation ensures that $p = k + p^* + e$. The term $(p^* + e - p)_{t-1}$ measures the deviations from PPP in previous period. So, p_t is adjusted in response to changes in (p^*_t, e_t) and the previous disequilibrium in such a way that the process tends towards the long-run equilibrium or proportionality.

As can be easily understood, the ECM differs from other dynamic models in that the steady-state solution is incorporated within the model and this restriction is easily testable as well. The idea is simply that a proportion of the disequilibrium from one period is corrected in

the next period.[9]

3.2. The Data

In this study, PPP has been tested for official exchange rates. Tests are processed by comparing Turkey with USA and West Germany separately.

The time period covered is between January 1980 and December 1989. Including the earlier years may affect the PPP testing, because of concrete differences between policies used before and after 1980.

While deriving the inflation rates for each country, Both WPI and CPI has been used. The data for Turkey has a source of State Statistics Institute and the data for foreign countries are taken from International Financial Statistics. In this study, the base year for the price indices has been chosen as 1980.

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9. see Davidson, Hendry, Srba, Yeo (1978), Engle and Granger (1987) p. 251

3.3. Estimation Results

In the present study, PPP hypothesis was estimated using both WPI and CPI, the former reflecting the traded price levels and the later reflecting the general price levels.

Initially, the error correction model was estimated with three lags for both indices, such as

$$\Delta p_t = a_0 + \sum_{j=0}^{3} (a_{1j}\Delta p^*_t + a_{2j}\Delta e_{t-j} + b_j\Delta p_{t-j-1}) + \beta(p-e-p^*)_{t-1} + u_t$$

The coefficients of both foreign prices and exchange rates are expected to be positive. The a_j terms capture the short-run effects on the exchange rates while ß identify the long-run influences. The basic PPP proposition i.e., long-run homogeneity of exchange rate with respect to relative prices is tested by the imposition of ECT; (p-p*-e). The significance of ECT indicates that agents corrected a proposition of previous disequilibrium in exchange rates.

In addition to the statistical and economic interpretation of estimated coefficients, the diagnostic checks as a model acceptance

criteria has been proposed in order to further improve the quality of time series modelling.[10] Accordingly in this study, for each model, the main test criteria are: goodness of fit by R^2 and SER, absence of residual autocorrelation by LM test, absence of residual heteroscedasticity by H.C.S.E and t-ratio, predictive ability by CHOW test and residual normality by NORM test. In statistical terms, each criterion yields a testable null hypothesis. In our empirical tests in the following section, how the equations perform on these criteria was also investigated.

As it can be seen from Table 1 to 4, in the case of both WPI and CPI models since most of the lag coefficients are insignificant at 5 percent level, the lag structure of the models, have been changed to single lag model. Although in three lag models, the coefficients of ECT are significant at least 10 percent level, the explanatory power and other test statistics implied that the models have to be revised.

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10. see Davidson, Hendry, Srba, Yeo (1978)

Table.1. The PPP model, wholesale price index

(Turkish Lira / US Dollar)

Variable	Coefficient	H.C.S.E.	t-value
Δp_{t-1}	0.31356	0.08843	3.18949*
Δp_{t-2}	0.01780	0.09251	0.17255
Δp_{t-3}	-0.00177	0.09472	-0.01859
Δp^*_t	0.23478	0.48496	0.51361
Δp^*_{t-1}	-0.15305	0.47870	-0.30025
Δp^*_{t-2}	0.35349	0.44688	0.69029
Δp^*_{t-3}	0.76211	0.41820	1.68982**
Δe_t	0.90710	0.08327	0.94461
Δe_{t-1}	-0.01600	0.10087	-0.16720
Δe_{t-2}	-0.03105	0.08442	-0.34006
Δe_{t-3}	-0.00109	0.04057	-0.01965
$(p-p^*-e)_t$	-0.04011	0.01405	-2.82567*
Constant	-0.18491	0.07002	-2.60420*
T-K	103	ARCH	0.16/3.94*
SER	0.01858	NORM	70.94/5.99*
R^2	0.23795	CHOW(20,79)	0.58/1.71*
LA(4,99)	0.164/2.46*	F(12,103)	2.68/1.85*

* critical value at the 5 percent significance level
** critical value at the 10 percent significance level

Table.2. The PPP model, consumer price index

(Turkish Lira / US Dollar)

Variable	Coefficient	H.C.S.E.	t-value
Δp_{t-1}	0.38347	0.08894	3.88595*
Δp_{t-2}	0.14075	0.09994	1.32890
Δp_{t-3}	-0.08423	0.11189	-0.86929
Δp^*_t	0.44321	0.36854	0.87869
Δp^*_{t-1}	0.15714	0.37377	0.32466
Δp^*_{t-2}	-0.11888	0.31706	-0.25073
Δp^*_{t-3}	-0.08806	0.32503	-0.18748
Δe_t	-0.03391	0.08343	-0.38313
Δe_{t-1}	0.00699	0.09014	0.07750
Δe_{t-2}	-0.00642	0.09657	-0.07398
Δe_{t-3}	0.08613	0.08225	1.88846**
$(p-p^*-e)_t$	-0.02128	0.01091	-1.76663**
Constant	-0.06905	0.04365	-1.40421
T-K	103	ARCH	0.34/3.94*
SER	0.01747	NORM	12.39/5.99*
R^2	0.28118	CHOW(20,83)	0.81/1.70*
LA(4,99)	0.54/2.46*	F(12,103)	3.36/1.85*

* critical value at the 5 percent significance level
** critical value at the 10 percent significance level

Table.3. The PPP model, wholesale price index

(Turkish Lira / Deutche Mark)

Variable	Coefficient	H.C.S.E.	t-value
Δp_{t-1}	0.29770	0.10057	3.11759*
Δp_{t-2}	-0.03424	0.07835	-0.34455
Δp_{t-3}	-0.07500	0.09625	-0.85550
Δp^*_t	0.93295	0.63184	1.46153
Δp^*_{t-1}	0.18244	0.59237	0.29936
Δp^*_{t-2}	0.69778	0.60900	1.16778
Δp^*_{t-3}	0.09207	0.61763	0.14532
Δe_t	0.06259	0.07485	0.76685
Δe_{t-1}	0.02805	0.11882	0.32541
Δe_{t-2}	0.04935	0.09552	0.61300
Δe_{t-3}	0.04189	0.05512	0.83728
$(p-p^*-e)_t$	-0.03486	0.01178	-3.16844*
Constant	-0.13204	0.04954	-2.89194*
T-K	103	ARCH	0.02/3.94*
SER	0.01831	NORM	48.17/5.99*
R^2	0.26041	CHOW(20,83)	0.61/1.70*
LA(4,99)	0.64/2.46*	F(12,103)	3.02/1.85*

* critical value at the 5 percent significance level

Table.4. The PPP model, consumer price index

(Turkish Lira / Deutche Mark)

Variable	Coefficient	H.C.S.E.	t-value
Δp_{t-1}	0.33346	0.09492	3.49815*
Δp_{t-2}	0.11630	0.10433	1.16388
Δp_{t-3}	-0.11785	0.10348	-1.28205
Δp^*_t	1.23429	0.62697	1.90510**
Δp^*_{t-1}	-0.24962	0.63052	-0.36637
Δp^*_{t-2}	-0.72553	0.71175	-1.08025
Δp^*_{t-3}	0.23050	0.80287	0.36029
Δe_t	0.16210	0.07468	2.31131
Δe_{t-1}	-0.11962	0.08414	-1.52604
Δe_{t-2}	-0.03808	0.07677	-0.52526
Δe_{t-3}	0.07224	0.05495	1.75608
$(p-p^*-e)_t$	-0.02883	0.01081	-2.54257*
Constant	-0.06980	0.03314	-2.03462*
T-K	103	ARCH	0.36/3.94*
SER	0.01641	NORM	4.34/5.99*
R^2	0.36552	CHOW(20,83)	0.81/1.70*
LA(4,99)	1.02/2.46*	F(12,103)	4.94/1.85*

* critical value at the 5 percent significance level
** critical value at the 10 percent significance level

In Table.5, the estimation result of the PPP model for the WPI of TL/$ case was reported. In this model, foreign price has the right sign and is significant at 10 percent level. Exchange rate has also the right sign and is significant at 5 percent level. In addition to these variables, ECT is significant at 10 percent level and the indicates the 2.3 percent of deviation of exchange rate from PPP is amended each month. The goodness of fit measure, R^2 indicates that the model explains more than 50 percent of the variations in the domestic price level.

Table.5. The PPP model, wholesale price index

(Turkish Lira / US Dollar)

Variable	Coefficient	H.C.S.E.	t-value
Δp^*_t	0.58111	0.45703	1.39749
Δe_t	0.44389	0.25626	10.50045*
$(p-p^*-e)_t$	-0.02293	0.01400	-1.75710*
Constant	-0.09908	0.06864	-1.50381
T-K	115	ARCH	0.47/3.93*
SER	0.02027	NORM	16.52/5.99*
R^2	0.51799	CHOW(20,79)	0.21/1.71*
LA(4,99)	3.33/2.45*	F(3,115)	41.19/2.68*

* critical value at the 5 percent significance level

From Table 6 to 8, other estimation results were reported. In West Germany case, the coefficients of ECT are even significant at 1 percent level and reveal that almost 4 percent deviation of exchange rate from PPP is amended each month.

Table.6. The PPP model, consumer price index

(Turkish Lira / US Dollar)

Variable	Coefficient	H.C.S.E.	t-value
Δp^*_t	0.50210	0.57324	0.90587
Δe_t	0.31153	0.27222	7.22596*
$(p-p^*-e)_t$	-0.01253	0.01026	-1.16402
Constant	-0.02818	0.03863	-0.65193
T-K	115	ARCH	0.74/3.93*
SER	0.02096	NORM	15.14/5.99*
R^2	0.32879	CHOW(20,79)	0.38/1.71*
LA(4,99)	3.47/2.45*	F(3,115)	18.78/2.68*
F(3,115)	18.78/2.68*		

* critical value at the 5 percent significance level

Table.7. The PPP model, wholesale price index

(Turkish Lira / Deutche Mark)

Variable	Coefficient	H.C.S.E.	t-value
Δp^*_t	2.15237	0.95866	3.97279*
Δe_t	0.39419	0.30221	10.35383*
$(p-p^*-e)_t$	-0.03880	0.01205	-3.24484*
Constant	-0.12428	0.04723	-2.87261*
T-K	115	ARCH	1.41/3.93*
SER	0.02035	NORM	7.56/5.99*
R^2	0.51407	CHOW(20,79)	0.33/1.71*
LA(4,99)	6.17/2.45*	F(3,115)	40.55/2.68*

Table.8. The PPP model, consumer price index

(Turkish Lira / Deutch Mark)

Variable	Coefficient	H.C.S.E.	t-value
Δp^*_t	2.29682	0.86085	3.48754*
Δe_t	0.30235	0.15774	8.50823*
$(p-p^*-e)_t$	-0.03860	0.01059	-3.70096*
Constant	-0.09845	0.03102	-3.06865*
T-K	115	ARCH	3.54/3.93*
SER	0.01897	NORM	2.64/5.99*
R^2	0.44995	CHOW(20,79)	0.26/1.71*
LA(4,99)	2.32/2.45*	F(3,115)	31.36/2.68*

* critical value at the 5 percent significance level

In almost all equations, the significance of the coefficient of ECT implies that the PPP proposition i.e. long-run homogeneity of exchange rate with respect to prices holds. However, from the most of the test statistics, we can say that the models are not performing well . Thus, the methodology can be further investigated.

3.4. Test of Cointegration

At the least sophisticated level of economic theory lies in the belief that certain pairs of economic variables should not diverge from each other at least in the long-run. Thus such variables may drift apart in the short-run but if they continue to be too far apart in the long-run then economic forces such as market mechanism or government intervention will begin to bring them together again.[11] However, in each case the correctness of the beliefs about long-run relatedness is an empirical question. The idea underlying cointegration allows specification of models that capture part of such beliefs in macroeconomics.

In particular, Granger and Engle (1987) states that if a vector of

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11. see Granger (1986) p.213

time series are cointegrated then there exists a valid error correction representation. This study also draws on the theory of cointegrated process to test whether PPP holds as a long-run equilibrium relationship. The equilibrium relationship captured in the absolute version of PPP assumes that perfect commodity arbitrage acts as an error correction mechanism to force the TL price of a consumption bundle of Turkish goods in line with the TL price of a consumption bundle of foreign goods. If PPP is true, inter-country commodity arbitrage ensures that deviations from a linear combination of spot exchange rates and relative prices should be stationary. Since cointegrated system allows individual time series to be integrated of order one I (1)[12] but it requires a linear combination of series to be stationary, PPP is testable using the theory of cointegrated processes. In particular, imposing the theoretical restriction on the cointegrating vector, the long-run equilibrium of PPP holds if real exchange rate is stationary.

Granger and Engle says that "if each element of a vector of time series x_t, first achieves stationarity after differencing, but a linear

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12. see Granger and Weiss (1983), Engle and Granger (1987) for the definition of I(1)

be combination of ß' x_t is already stationary, the time series x_t are said to cointegrated with cointegration vector ß'. Interpreting ß' x_t=0 as a long-run equilibrium. Cointegration implies that deviations from equilibrium are stationary with finite variance. The absolute version of PPP has already been expressed as $P_t=E_tP^*_t$. Thus the equilibrium condition can be written as ß' x_t=0 where ß'=(1,-1,-1) and x_t'=(ln P_t, ln E_t, ln P^*_t). In most time periods x_t will not be in equilibrium and z_t=ß' x_t is called the equilibrium error. In particular, the theoretical restriction on the cointegration vector ß has been imposed and tested whether the real exchange rate ß' x_t is stationary. In other words if ß' x_t posses a unit root[13], there exists permanent divergence from PPP (i.e., no need for ECM modelling).

For the test of cointegration, three different test has been conducted. These are;

1.The Co-integrating Regression Durbin Watson (CRDW): After running the cointegration regression; $p_t = k^* + a(p^*_t + e_t) + u_t$, the DW statistic is

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13. see Said and Dickey (1983), Dickey, Bell and Miller (1986)

tested to see if the residuals appear stationary. If they are nonstationary DW will approach to zero and thus the test rejects non-cointegration hypothesis.

2.Dickey-Fuller (DF) Test: This tests the residuals from cointegrating regression by running an auxiliary regression as described by Dickey and Fuller. It also assumes that the first order is correct.

DF regression: $\Delta u_t = -b u_{t-1} + u_t$.

3.Augmented Dickey-Fuller (ADF) Test: This test allows for more dynamics in the DF regression and specified for higher order cases.

ADF regression: $\Delta u_t = -b u_{t-1} + c_1 \Delta u_{t-1} + \ldots + c_n \Delta u_{t-n} + u_t$.

First, both dependent and independent variables are tested by ADF as if they are I(1) or not so, the results are presented in Table 9. In the test, the number of lags was chosen to be 5 and the results were found to be insensitive to other lags.

Table.9. Unit Root Test

Variables	Coefficient	ADF
WPI	1.00195	-4.30641*
CPI	1.00344	-4.79947*
US (WPI)	0.96867	-2.79138*
US (CPI)	0.98568	-3.32009*
G (WPI)	0.96709	-2.54697
G (CPI)	0.97956	-4.74306*
US DOLLAR	0.99203	-2.84458*
DEUTCHE MARK	0.99939	-4.15799*

* significant values; (1% = -3.77, 5 % = -3.17, 10% = -2.84)

Since almost all the variables in the model are integrated of order one; the test of cointegration by three different test has been presented in Table 10.

Table.10. The PPP model, cointegration tests

	CRDW	DF	ADF
TL/$ (WPI)	0.076/0.386*	-1.833/-3.37*	-0.719/-3.17*
TL/$ (CPI)	0.055/0.386*	-1.268/-3.37*	-0.622/-3.17*
TL/DM (WPI)	0.100/0.386*	-1.104/-3.37*	-1.986/-3.17*
TL/DM (CPI)	0.119/0.386*	-1.045/-3.37*	-1.705/-3.17*

* critical values at 5 percent significance level

We cannot rejects the null hypothesis that the real exchange rates for both TL/$ and TL/DM have a unit root (non-cointegration hypothesis is failed to rejected) for all prices considered. This conclusion implies that the deviation from PPP have no tendency to converge to a long-run equilibrium. Moreover linear regression involving domestic and foreign price levels can only be interpreted as spurious regression in the sense of Granger and Newbold (1974).

4. CONCLUSION

This study has reviewed the most popular exchange rate determination theory, PPP for the Turkish case. The most central features of the PPP doctrine is the long-run proportionality between the exchange rate and relative price levels in the home and foreign country. The error correction framework allowed the direct test of long-run equilibrium relationships of PPP.

When the simple PPP model was estimated over the time period January 1980 and December 1989, for Turkey-USA, and Turkey-West Germany cases separately, the proportionality hypothesis was not not rejected. This implied that in the long-run, PPP must hold. While testing PPP by ECM, exchange rate-relative price relationship has assumed to be cointegrated. However, although the long-run proportionality coefficients between the exchange rate and relative price levels are significant in the models, unit root or cointegration tests on the modelling lead to the result of divergence of PPP even in the long-run. Thus, although the study puts two contradictory results about the long-run equilibrium of PPP theory, the findings set up a groundwork for further research and practice in Turkey.

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