Does the Relative Purchasing Power Parity Theory Hold for TL/Dollar Exchange Rate?

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ETHICAL DECLARATION

I, Hamza Ahartane, hereby, declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct. I have fully cited and referenced all materials and results that are not original to this work.

Hamza AHARTANE

DEDICATION

To my dear parents in testimony of my gratitude for their love, their affection as well as the sacrifices they made for my education and my training.

To my brothers, my cousin for their support.

To all the other members of my family Please find in this modest work the expression of my affection.

To my teachers, to whom I pay a great tribute for their contribution to my knowledge throughout the course of my studies.

To my friends and all who are dear to me in recognition of a trust that the words cannot describe.

To all my beloved.

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ABSTRACT

The present work reviews the validity of the literature on the idea of purchasing power parity **(PPP)** and present actual data supporting the claim for the Turkish lira/Dollar **(TRY/USD)** exchange rate, during the 2015-2022 period .The Turkish lira/Dollar exchange rate represents the currency of the United States of America **(U.S.A)** and the currency of the Republic of Türkiye .The data collected for this project are the Turkish lira/Dollar exchange rate and the inflation rates of USA and Türkiye. Turkish Lira was officially introduced as a currency in 1844 by the Ottoman Empire, while as for the dollar it was created in 1862 as a form of green notes referring to their green color, as they were developed officially in 1869 and 2005 respectively. The ppp implied Turkish lira/Dollar exchange rates are compared with actual Turkish lira/Dollar exchange rates to see whether the parity holds, and this will be by conducting a regression analysis to test the validity of the PPP theory. Empirical research has refuted the widely held belief that the purchasing power parity holds only over the long term and the tests and empirical results in this project show that the PPP theory is unsustainable for the exchange rate between the Turkish Lira and the US Dollar, in our study it confirms the invalidity of this latter in the period of study and may or may not present the reliability over the long period of time in further cases.

Keywords: Purchasing power parity, Turkish lira/Dollar exchange rate, inflation rate.

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LIST OF ABBREVIATIONS

ADF   Automatic direction finding

AUD   Aussie or Australian dollar

CAD   Canadian dollar

CBRT   Central Bank of the Turkish republic

CIRP   Covered interest Parity

COVID-19   Coronavirus Pandemic 2019

CPI   Consumer Price Index

EURO   European Currency Unit

FED   Federal Reserve Board

FRED   Federal Reserve Economic Data

FX   Foreign Currency

GBP   British Pound Sterling

GDP   Gross Domestic Product

HSBC   Hong Kong and Shanghai Banking Corporation

HX   Home Currency

IMF   International Monetary Fund

IRP   Interest Rate Parity

MAD   Moroccan Dirham

NYSE   New York Stock Exchange

OTC   Over the Counter Market

PPP   Purchasing Power Parity

STAR   Situation Task Act Result

STX   Shanghai Stock Exchange

TL   Turkish Lira

UIP   Uncovered Interest Rate Parity

USA   United States of America

USD   United States Dollar

WPI   Wholesale Price Index

YUAN   Chinese Yuan

CHAPTER 1

INTRODUCTION

During 2018, while Türkiye was recovering from a currency crisis followed by a recession a global financial tightening occurred hurting emerging markets and Türkiye was one of its preys, the exchanges rate between the dollar **(USD)** and Turkish lira **(TL)** have seen a depreciation in the value of the TL by 31%, which led to the drowning of multiple firms in the banking sector and the increase of unemployment rate unseen since 2008 collapse; this latter's data helped banks to restructure loans worth 20 billion USD to secure their assets in October 2018.Even though the help given from the politicians it wasn't enough to revitalize the credit market in March 2019, Türkiye have seen a positive economic growth during 2019 by 2.9 %, but economics have classified Türkiye 's economy as an economic turmoil leading to a recession due to their dependent financialization. During these years a virus called COVID-19 emerges and impacted the Turkish republic and the whole world in matter of inflation and geopolitical conflicts. After the post COVID-19 all countries around the world suffered from the decrease of their gross domestic product **(GDP),** industrialization and other sectors such as tourism and healthcare (Akcay, & Gungen, 2019).

Inflation today was the main actor after the COVID-19 pandemic **(coronavirus disease)**,which as I stated before resulted not just to health issues but to an economic disaster that all countries are suffering from; This inflation have led the US government and the FED **(federal reserve board)** to take urgent decision in order to stop the leak by increasing interest rates of bonds and loans in the USA,to maintain price of commodities, raw materials in balance and going back to normal

life ,but in the other hand Türkiye didn't take it seriously and decided to maintain the same interest rates in order to protect the purchasing power parity of its citizens and also encouraging investors to stay in their country, but everything has a price ,now Türkiye's currency known as the Turkish lira had a devaluation of 70% and inflation rate which was up to 75.48 % in 2023.Economic disasters and Türkiye have a long history together and nowadays history is repeating itself, the inflation rate of different countries and regions such as the EURO region are increasing nearly in each quarter to maintain inflation, the USA was the first country to unleash the rise of interests on treasurer bills and bonds, thus making the life even more complicated for emerging markets to keep on the same roots after the pandemic, and nowadays every country round the world is suffering from high level of inflation such as the European union , the USA , Türkiye and may other countries (Akcay & Gungen, 2019).

The ''IRP'' and the ''PPP'' were the most commonly subjects traded, in Türkiye inflation roses to nearly 80% which made the Recep Tayipp Erdogan and the CBRT to take decision in order to save the purchasing power of their citizen so they choose to increase the salaries and not the interest rate on bonds and treasury bills and loans which was the mainly question that was seen as unpredictable.

These choices and decisions have now led Türkiye to a very deep problem that will cause a collapse of their currency, because the interest rate and inflation rate are related by the parity relationships; the topic that we will analyze in our project is going to make it easier to see whether the Turkish administration is taking wrong step in order to slow inflation and stop it or are they taking different choices that will trigger a new economic tool that will help further generations to benefit from it, the economics point of view is pessimistic because of the rules of the law

of price on money market and currency market. We are seeing a bullish trend for the Turkish Lira against different currencies due to contradictory policies taken against the world monetary system which consists on elevating interest rates to alleviate the inflation level and save the purchasing power of Turkish citizens.

The ppp implied Turkish lira/Dollar exchange rates are compared with actual Turkish lira/Dollar exchange rate to see whether the parity hold, and this will be by conducting a regression analysis test the validity of the PPP theory. Empirical research has refuted the widely held brief that the purchasing power parity holds only over the long term and the tests and empirical results in this project shows that the PPP theory is unsustainable for the exchange rate between the Turkish Lira and the US Dollar, in our study it confirms the invalidity of this latter in the period of study and may or may not present the reliability over the long period of time in further cases.

In chapter 2, a description of the history of Turkish lira and relevant studies on the TL are given with regard to study's outline. The common terminology used in the chapter that follows is provided in the first section. After that, the consumer price parity definition and literature review and parity in interest rate and synopsis of relevant studies are given. The source of the data employed for this study, how PPP was created, and the real Turkish lira/Dollar exchange rate and the research hypothesis that were evaluated are all covered in the chapter on data and methodology. The outcome of the study are presented, and chapter 5 offers explanations of these findings. The insights founded on this study's findings, its limitations, and potential areas for further research are all included on the closing section.

CHAPTER 2

TURKISH LIRA HISTORY AND REVIEW OF

RELATED LITERATURE

2.1 Turkish Lira History

On March 1844, the Ottoman Empire introduced a form of currency called Lira, which was replaced at the time by the basic currency the Kurus which was subdivided into Lira. Türkiye has a turbulent history concerning their currency which was suffering from high volatility and uncertainty moreover inflation, Lira was weighted of pure silver or pure gold which at the time 1 lira=99, 8292 gram, while 1lira= 6,615 gram respectively.

In 1870, Germany was the first nation in the world to relate their currency to gold which was known during that period as gold standard, in which other nations were influenced by idea and practically using it, From 1870 to 1920 the gold standard was the basis of international monetary system in which Türkiye had abandoned during the first war in 1917 and the Lira sky rocked by losing its value to nearly 20%.

The falling of the Ottoman Empire had made the Central bank of the Turkish republic and Turkish government afterwards to think about their financial monetary policies which resulted on the creation of the Turkish lira in 1923. The Turkish central bank tried to relate their currency to other countries currency such as the pound sterling and French franc to stabilize their monetary system from volatility by forming a basket of different currencies to diversify their portfolio in order to keep the currency markets equilibrium. in 1946 the US dollar was fixed at a rate of

1USD= 2.8 Turkish lira, it didn't take too long for Türkiye to recover from their failure, the inflation began to rose and led into the devaluation of their currency, as a consequence of their chronic inflation the exchange rates showed a high fall of the Turkish lira from 1970 to 1990. (Central Bank of Turkiye)

From 1995 to 1997 Turkish was classified as third's less value currency by the Guinness book of records, even though in the recent years in 2005 Turkish lira became stabilized and began to gain some value, a new Turkish lira was adopted in 2009 by the same name, in which Mustapha Kamel Ataturk the founder of the Turkish republic.

2.2 Review of Related Literature

In this part, we are going to examine Türkiye 's tremendous changes of its currency known as ''the currency crunch'' during 2018 and the factors responsible for these volatility such as the behavior and the performance of investors (foreign or local institutions and individuals), the lack of foreign exchange reserve that could have led to a collapse in the country's exchange rates during 2019-2020, moreover the speculative attacks made in exchange market by traders and their access to the information ,finally the policies made by ''Recep Tayip Erdogan'' administration in order to decision during the post crunch and nowadays.

Türkiye 's currency have always been a subject of uncertainty and high volatility due to the high speculations in the exchange markets and new policies made by their entities, since 2018 their currency have seen pressure more often; the central bank of Turkish republic(CBRT) have made strange decision concerning their monetary policies for example, the high level of inflation in the world had made other nations to think about the long run solutions such as increasing the

interest rates to minimize the consumption and lower the size of liquidity in the market, the FED decided to increase their interest rate since 2018 to nowadays exceeding to a level of 4% which is very high compared to Türkiye in which their CBTR decide to leave the same interest rate since 2018 until today and even lowering it, as we recognize one of the primary issues Türkiye is dealing with is the interest rate parity which affects directly the buying power parity of the population. The interest rate in the Turkish republic have a significant impact on local or foreign investor's behavior and performance, the decline in Turkish lira made investors uncertain about their future profits due to lower interest rate which made demand on TL by these investors to decrease and devaluate overtime (Central Bank of Turkiye, 2017).

The major problem concerning the currency crunch of TL started in 2017, when the Turkish republic decided to change their perception on their monetary policies which means going away from the rule of law in other words being a strong currency depending on their rules not the international one.(no more data is affect in this subject due to the lack of freedom and expression ((''Huriyet daily new ,2018'')).On January 2018,one the most underrated and successful companies decided to close their office in Istanbul known as the ''Fitch agency'', afterwards on February 2018 also another agency called ''Yildiz Holding'' have seen tremendous changes in CBTR policies, in which this company is applied to restructure a debt worth 7billions USD ,at that time panic enters the market and the first cracks began to appear on foreign corporate debt Turkish companies (Central Bank of Turkiye, 2017).

On August 2018, the beginning of investor's behaviors and performance changes has begun to define itself, foreign institutions already predict the calamities

in the Turkish market and only few days off the TL lost 33.7% of its value against the USD, thus it helped them make enough profit, which means that foreign institutions had access to intelligence rather than any other investors which made the Turkish stock market and foreign exchange market to decline during 2018,but no evidence confirms the stated opinion due to several studies made in different countries such as Japan and South Korea for instance.

Local and foreign individuals didn't have much influence because they were bad market timers, while local's institutions performance was on average of returns even though the balance sheet shows a negative aggregate, This was an opportunity for these foreign institutions to expand and rise their holdings in companies due to high sell imbalances made by foreign institutions who had access to information after the policies made by the CBTR and ''Recep Tayipp Erdogan'' administration to support local entities with more liquidity (International Monetary Fund, 2018).

The figure 1 below schematize the fluctuation of the Turkish lira against an equal basket of the Dollar from 1999 to 2023:

Figure 1

Exchange Rate for USD/TL from 1990 to 2023
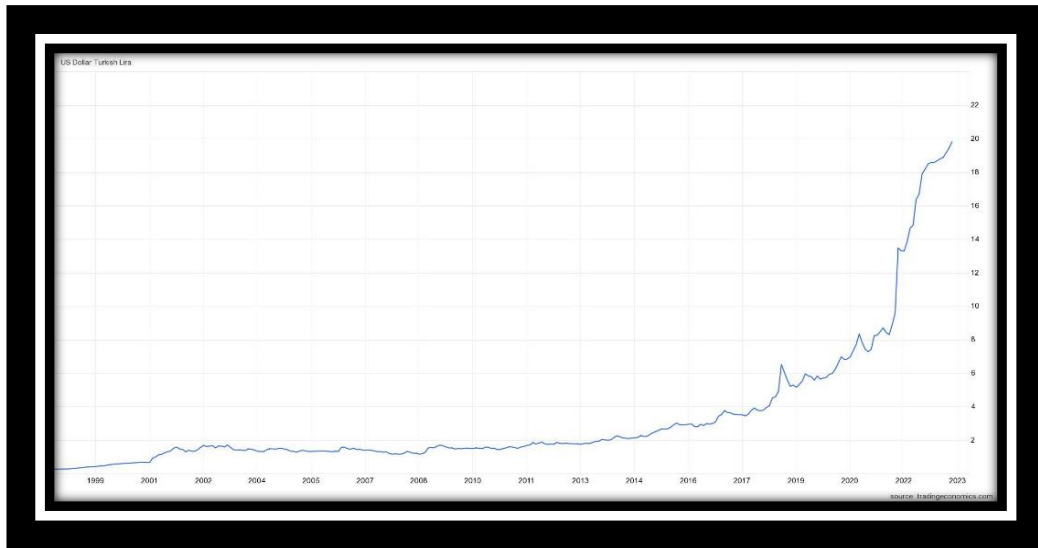
Retrived from the Federal Reserve Economic Data of St. Louis (Not seasonally Adjusted,

Annual Frequency; National Currency Units per US Dollar).

Source: University of Pennsylvania.

CHAPTER 3

THEORIES OF PARITY TO BE ANALYZED

The PPP doctrine and IRP one has been a subject of study during decades, in this scope we are going to examine firstly the common terminology of exchange rates and then we will provide details about each theory.

3.1 Terminology Used to Describe Exchange Rates

One of the most notable worldwide financial market is the market for foreign exchange where trading of global currencies are being bought and sold, this market's primary function is to make easier global commerce and investment. To make things simpler for the reader to understand financial international management, we are going to focus on how these operations are being held and their mechanisms (Krugman, 1978).

The main goal of the overseas currency market is to exchange a particular currency for a different one, for instance: a Turkish corporation importing items from the USA may need to shell out for these products, and may purchase dollars in the marketplace for foreign currencies using its Turkish Lira. However an industrial corporation from the USA exporting merchandise from Türkiye may need as well passing by the foreign exchange market, we don't have to forget that TL is in the minor exchange market currencies, so this means that the US Company receive their payments in TL(not available for future market).

A virtual market is the foreign exchange market, trading in currencies via foreign exchange brokers, financial institutions, international enterprises and central banks are handled through the telephone communication or digitally.

Traders operate by means of ''meum pactum'' or ''word is my bound'' spectrum in the foreign exchange market, while most currencies traded worldwide through the interbank and over the counter market **(OTC)** which are the wholesale foreign exchange market which includes the spot and the forward market that we will be explain in the next part (Krugman, 1978).

3.1.1 Spot Market

Defined as a market in which products such as commodities, currencies and stocks are traded for immediate distribution with delivery implying monetary exchange for a parameter of finance ; Called also ''cash markets'' or ''liquid markets'' fund take time to be legally transferred within a period of time limited to 2 days between the buyer and the seller. The current price is considered to be the immediate price of selling and buying the commodity, which can shift in matter of second after sellers and buyers enters new positions as the orders are filled. The New York stock exchange (NYSE) is a manifestation of a trading platform where traders purchase and sell securities.

The spot exchange rate is the amount indicated instantaneous payout on an interest rate, it gauge the real time market supply and demand for an item that may delivered immediately, from the foreign exchange perspective it is seen as an outright rate or also what is called ''Benchmark rate'', commodities are founded on supply and demand aggregate while bonds are based on the zero coupon rate which are widely publicized by news for these traders.

Let's give an example on how this spot rate works; lets today's exchange rate between Turkish Lira and dollar is: TL 19, 95/USD this means that for 1 USD you need 19, 95 TL for immediate delivery which stand for direct quotation, informal

quotation in the opposite side direct quotation for a single currency is an indirect quote for another such as USD 0,051/TL for USA is an indirect quite for Turkiye.

Generally in the spot market there's no physical delivery, so most traders use options for a currency pair or a security, buy or bid price is commonly referred as the initial rate whereas the following is known as the offer or the ask price and by means of spread which is the difference between the two prices stated traders can generate profits (Berberoglu, 2004).

3.1.2 Forward Market

The forward market is a private agreement traded in the over the counter market that's sets the price for a future delivery of a commodity at a predetermined date (maturity date), its main function is to minimize the risk of fluctuation on a transaction for a financial instrument over a period of time in the future (predetermined). In this market, contracts are executed between banks or banks and customers fulfilling the requirements of the customer by means of date of maturity and contract size, this process will define the forward rate and may be settled in cash in some cases (Engel, 1996).

The Forward rate is a specified price agreed on for the delivery of a product at yield of maturity, it can be speculative if buyers sees opportunity and positive return in the price of the good which means that the current forward price will be lower than the future price of the commodity while in other had sellers use this rate to make hedging to minimize loses.

The forward rate formula is below:

Forward rate = Spot rate x (1 + foreign interest rate) / (1 + domestic interest rate).

Let's give a true example on why forward market are important in time where everything is full of uncertainty: Let's assume that the price of the commodity in 1 January 2023 was 1 Million TL, in 1 January 2023 the TL was 18,69 per 1 USD, if I decided to buy a commodity at that time (1 January) with the same exchange rate, and on the May 8 I'm waiting for delivery I would gain a lot of money due to the fluctuations in the exchange rate of the TL which is equal today to 19,95TL per 1 USD ,Even though the price today had increased, I would receive my product with the same price agreed on 1 January which 18,69 /1USD in the forward contract.

3.1.2 Arbitrage

Arbitrage is an act of buying and selling commodity on the different markets, it can be described as discrepancy in quoted prices with low risk involved in the strategy, in other words buying a commodity where market prices are low and selling it where market prices are high, thus enabling investors to profit from the price differential in cost per share (Akram, et al., 2008).

Let's illustrate this subject by providing an example below that will facilitate the understanding of arbitrage even if it's complication for the untrained eye; the explanation of this strategy is defined as when the price of the stock is not yet adjusted in the exchange market which is called a state of flux, the price on the local exchange is overvalued compared to the price of the stock on the foreign

exchange, this strategy is a straightforward trades that harvest gains from this differentials.

On a normal day, HSBC bank trades on both New York stock exchange (NYSE) and Shanghai Stock Exchange (STX): the stock trades 379,80 Chinese YUAN on the STX and 55 USD on the NYSE, if the exchange rate USD/YUAN is 6,92 which means 1USD=6,92 YUAN, where 55USD=380,06YUAN,a trader can purchase HSBC shares from the STX by 379,88 and sell it at the same time in the NYSE by 380,06,which will help him make a profit of 0,26 USD per share and this is called a ''Currency arbitrage''.

A ''triangular arbitrage '' is a series of foreign currency transactions seen as a unique form of trading, which involves three different currencies in it, the first can be used to harvest gains from differentials in the traded markets when they do not match up. These opportunities are only made by traders with high tech equipment and tools. The example below is an exchange rate pricing of a bank for the dollar, pound sterling and Turkish lira (Akram, et al., 2008).

Let's assume you have 20000 USD and the given exchange rates are as follow:

TL/USD= 0,038   ; TL/GBP=0, 30   ; USD/GBP=1,45

An arbitrage opportunity is on the arisen:

1. Sell dollars to buy TL 20000:0,038=526315,78

2. Sell euro for pounds: 18181, 81:0,03=606033,33

3. Sell pounds for dollars: 14430, 01$*1, 45=20923, 57

4.   20923, 57-20000=923, 57;

The trader will receive an arbitrage profit of 923, 57 USD

Effect of the triangular arbitrage will be resumed on table 3.1 below: *(Berberoglu, 2004)*

Table 1

The Significance of the Triangular Arbitrage on the USD, TL and GBP

Activity,	Impact
Traders use dollars to buy Turkish Lira	Increase in the ask price of euros by bank.
Traders use Turkish Lira to buy pounds	Reducing in bid price from the bank for the British pound, and reducing the number to exchange in euros
Traders use pounds to sell dollars	Reducing in bid price for the British pound.

3.1.2 Foreign Exchange Rate Determination

A lot of factors determine the foreign exchange rate and there are multiple ways of calculating the currency exchange rate, firstly the interest rate, speculations and secondly the inflation rates, which they refer respectively to the fixed exchange rates, floating exchange rate.

The cost of one currency is outlined as the foreign exchange currency related to another currency, the sheer amount of demand and availability of the foreign currency (FX) is its determination, these FXs are used to by commodities or securities and capital outflows for another country, the demand on FX will have an opposite relationship of goods and services, various variable are affected by the

supply and demand for cash and are interest rate, expectations and level of the prices (Inflation) and income levels .

The demand of goods and services from another country (Example let's assume the USD currency and USA is the home country) pushes the FX to be supplied, these transactions needed from the home country (USA) on order to buy asset have to be paid in USD, but there are several parameters that will determine the exchange rate between the home and the host country such as the US interest rates, inflation rates, income levels and liquidity supply and free markets and we should mention that all of these variables are linked and have a relationship in the international finance they are bonded by the spot exchange market, forward exchange rates, interest rate, PPP and IRP.

The quantity of money is referred to as the interest percentage that a lender or a central banks provides to commercial banks or an investor with a certain percentage or a return on investment during a specified period; for example if a third world country wants to take a loan from the International monetary fund (IMF) they will have to pay an extra amount of money at the yield of maturity which is called the interest rate determined in percentage. The difference in interest rate is dubbed to as ''interest differential'', for example a three years interest on US bonds might be equal to 5% while on the other a three years interest on the Turkish bonds is 7%, let's assume that Türkiye is the home currency (HX) and the USA is the FX, thus the difference between the two (7%-5%=2%), is the differential interest rate between Türkiye and USA,thus Türkiye is providing higher return on three years bond than the USA by 2%. The ''*PPP*'' is the current exchange rate that takes inflation differentials into account between 2 nations according to this popular linkage in financial circles; in other words, if the prices of commodities in Türkiye

increases more than the US currency, to satisfy the PPP condition the Turkish lira have to depreciate against the US dollar.

Inflation is one of the words that are commonly traded nowadays, ''inflation rate'' is the percentage of increase in goods and services during a period of time which usually a year. Consumer price index commonly utilized in countries in order to measure inflation, it measures an average consumer's cost of living by conducting surveys to identify a basket of goods and items purchased such as housing expenses and rent, and the cost of this basket over a period of time mostly a year will determine whether there is an increase or decrease in the costs of living which is defined as PPP.The difference between 2 nations inflation rates is referred as the inflation differential. For example, the inflation rate in Türkiye is 33, 7% and in the USA is 11, 3%, let's assume USA is the HX and Türkiye is the FX currency, the inflation rate will be equal to 11,3%-33,7%=-22,4% which is negative, it means that Türkiye inflation is higher than the one in the USA (Segura, 2012).

The '*'IRP*'' which binds the two nation's interest rate of spot and forward exchange rate, essentially says basically states that the forward discount or premium must be equal the differences in interest rate, therefore the USD will be account as premium since the Turkish interest rate are higher than USD interest rate.

In the following section we will explain and define the IRP and PPP, as they are major links between all the variables related to the foreign exchange rate determination, moreover we will provide more details concerning the parity relationships of IRP where we will cover the PPP,IRP.

The FX parity relationships are vital to this manner:

- P.power.P
- CIRP
- Forward parity
- UIRP
- Domestic fisher effect
- International fisher effect

3.2 Purchasing Power Parity

3.2.1 Purchasing Power Parity Theory

Purchasing power parity doctrine, was first invoked in Spain in the period of Napoleonic wars and was propounded by the Swedish economist professor Gustav Cassel (1886-1945) in 1916, this latter was seen as the art of exchange models after the breakdown of the Bretton woods system and was used to establish an equilibrium in the exchange rates (Dornbusch, 1985).

The purchasing power parity theory states that one may say that the value of their home currency in terms of foreign currency falls as a result of an increase in home price level (Bailie & Osterberg, 2000).let provide an example of purchasing power parity between two countries which may confirm the stated definition. Suppose than 1USD purchase a basket of goods. The identical basket in Morocco costs 10 Moroccan dirhams (MAD), then the exchange rate would be 1USD/10MAD, let's assume now that the price of the basket in both countries are the same but the exchange rate changes to 1USD/11MAD.

This will make people go exchanges and convert their dollars into dirhams, they will buy the same basket for 10MAD and sell them in the USA for 1 dollar again, giving them the ability to make 1MAD profit in each basket, thus this will create a high demand on the MAD in the USA therefore Moroccan exports supplies are not relevant for the USA market in general (compared to china for example),somehow in the future the MAD will decrease to the normal exchange rate 1USD/10 MAD, at that point imports from Morocco will not give abnormal profits which is exactly the PPP between two countries, in others words supply and demand are key factors to determine relative exchange rate between two currencies as they indicate the purchasing power parity over goods and services.

The PPP can be divided into sections, the first section is the absolute PPP and the second is the relative one, in the next paragraphs we will elaborate these two as we already prepared examples for both of them (Dornbusch, 1895).

The PPP advocates the rule of ''law of one price'' principle which is an ''absolute'' form of PPP (Balassa, 1984), it states that if the price of a commodity in two countries is different, traders will exploit the price difference to gain profit using the spot exchange rate which is a form of arbitrage, (we must emphasize that the price of the goods is affected by the global exchange transactions ((Supply and demand)) moreover the low trade barriers and supply chain costs); In others words, when the prices of a goods are not equal in both countries by the spot exchange rate they will be related as P and P*(P:Domestic price ;P*:Foreign price) ,which it will determine the foreign exchange rate (S) by this rule, $S=(P)/(P*)$ and if they are equal it means that the PPP is on equilibrium and the relationship between P and P* will be equal to 1. For example, if a phone costs 1000 USD in the USA and the same phone on Türkiye is traded for 25000 TL, the exchange rate should be

1USD/25TL,however it would be possible for a Turkish citizen to sell the same phone on the US for more than 1000 USD, if the actual exchange rate were lower, which will enable him to make gains as a form of arbitrage with low risk advantage(no costs or trade barriers included),from the given example a Turkish citizen can start buying more TL and sell dollars until the devaluation of the TL to the normal exchange rate which 1USD/25TL,thus arbitrage opportunity will be canceled (Segura, 2012).

In practice, arbitrage makes traders look always for the lower price of the good to take the opportunity and sell it in other market with high prices, sometimes it cannot be beneficial because trade barriers and costs of transportation will eliminate the profit gained by traders, but in other cases of different commodity it can be beneficial (Chen, 2008).

Let's move on to the other section where the relative PPP which is a differentials of the absolute form of PPP, it states that the adjustments of price levels in two home countries will display the rate of exchange between local currency and any foreign currency. It may be stated as the following equations:

$$P=(S)(P^*) \rightarrow \%\Delta P = \%\Delta S + \%\Delta P^* \rightarrow \%\Delta S = \%\Delta P - \%\Delta P^*.$$

Where:

- ΔS : Foreign spot rate

- ΔP: inflation locally

- ΔP^*: foreign inflation

Local prices will grow which and the exchange rate will rise, thus, that the currency will depreciate overtime, let's assume that the 15% is inflation rate in

Türkiye and 10% in Morocco as an example then the TLs per MAD will be exchange rate will depreciate by 5% according to the relative PPP.

As a consequence, PPP remains a major doctrine that needs to discussed and analyzed over and over. PPP is essentials two major's reasons, the first one is benchmarking because exchange rate follows a number of series of each country such as GDP deflators, competitiveness, wholesale prices for all major industries and specially for developing countries, because Gustav Cassel argued that under or overvaluation of a currency or an asset cannot be discussed unless there's PPP, and the second one is to serve a prediction model for exchange rates related to the quantity theory of money (QT) which consists on money disturbing this two correlation between QT and PPP made it easy for governments and economics to analyze the international monetary policy of each country it's weaknesses and strengths (Balassa , 1984).

3.2.2 Literature Review on Purchasing Power Parity

The PPP theory has two timelines the first is the short term and the other is long run, in the long run the exchange rates tend to correct themselves to gain back equilibrium to those markets, while in the short run there's no evidence or confirmation of PPP doctrine, the composition of baskets and prices indices made it difficult for economists and scientists to predict the outcomes of PPP by multiple factors such as inflation differential ,trade barriers or tariffs, which makes the absolute PPP not to hold in the real life, that's why the relative PPP takes these percentages in consideration to conclude the difference between exchange rates and price levels of basket of goods by using different method (Adler & Lehmann, 1983).

In this literature, various approaches and analysis have been made by different scientists and scholars about Türkiye inflation and interest policies

proving that the PPP's data can be fruitful in the long run rather than the short one. The Purchasing P.P is an expansion of the one price rule which not include different prospective dialed within this theory such as transportation costs and trade barriers, the perception made by analysts is that the PPP in Türkiye from a macroeconomic context is correct if we convert foreign currencies into Turkish lira we can see the same prices (Dornbusch, 1985).

If we take the four common trading partners (China, Russia, Germany, UK) with Türkiye, we can use PPP as a benchmark to set prices for this nations and compare their exchange rates for trading, if PPP holds between one country in Türkiye it requires an equilibrium between the ratio of domestic to foreign currency equal to 1.Several Turkish and foreign economists have not found evidence of PPP and its impact on the exchange rates, Kalyoncu (2008) who was using a type of linear framework named as Dickey Fuller or ADF(Akdi & Dickey, 1984),tests have seen no evidence of PPP in Türkiye, while Gozgor (2011) and Yildirim (2017) who were using a nonlinear tests found stronger evidence of PPP in Türkiye and its trading partners ,while Ozdemir (2008) and Erlat (2004) find strong and weak evidence respectively for PPP for Turkish data. The idea of ADF tests was to conduct a test of exchange rate (Turkish Lira/Foreign currency) mixed with CPI or price consumer indices of each country aside. Their study showed no evidence of PPP between trading partners in the short run.

On the other hand, tests are used on Turkish lira exchange rates against USD and other currencies of Turkish trading partners, it states that exchange rate of Turkiye can be generated by an exponential smoothing or linear unit root (Erlat, 2004), and the evidence showed using CPI and WPI that there's a strong correlation between price levels of goods and exchanges rates indirectly which means that

using linear test alone cannot be sufficient unless it mixed with nonlinear testing procedures to find the correlation of exchange of Turkish lira against foreign currencies, however the effect those tests can be imbalanced or reduced as long as the Turkish lira can be overvalued.

In the short run, inflation can be a major factor in the increase of exchange rates in the long run but it is not the only factor resulting in these changes, in the late 90'S few countries from Asia have seen a substantial increase in the level of inflation but with no impact on exchange rates because they used covered interest rate arbitrage to make balance in the market. However, the currencies of these countries did not depreciate against the dollar because their high interest rates attracted large capital flows from the US investors (Pilbeam, 1998; Clark, Levasseur & Rousseau, 1993).Deviation in the PPP is going to be corrected in the long run which is the normal cycle on any country's PPP especially in emerging markets, because they are trying to stabilize their coin in order to the overvaluation of their currencies but after inflation rates go down their currency will be again depreciated, and the Mexican Peso is one of many examples in 1994 and the Russian Ruble in 2000.

An author examines the link between the American dollar and the Turkish lira conversion rate and the commodity cost level in logarithmic forms using nonlinear cointegration techniques by relating the Türkiye's CPI and the USA Ozdemir (2008), the study investigates the nonlinear STAR error correction model with the null which shows from the IFS database the null hypothesis is rejected at 10% and not rejected at 5%, Thus the empirical evidence shown weak evidence of PPP hypothesis for Türkiye.

Kayloncu (2009) apply different unit of test by determining whether the validity of PPP which is affected by the base country and test types, it is a test known as ADF which is a conventional unit root test, the result of his study taken from quarterly data of 2010 period support the long run PPP condition, while the tests of Türkiye are generally sensitive to the choice of the base country and the type of test applied.

Yildirim (2017) analyzes the PPP relationship with the exchange rates of the USA and some other trading partners, the study initially applies ADF and PP unit roots and finds evidence of PPP for exchange rate TL/USD, in which find support for PPP when the nonlinearities in real exchange rates are correctly specified.

The forms of PPP are not explicit, the aim of this literature is to compare different perspectives from different economists and scientists to prove whether the PPP holds in some conditions to see the efficacy of PPP and baskets of commodities in the Türkiye and USA, in which we can compare exchange rates of both countries before 2008 recession, the results show that over the stable exchange rate period there is more evidence that weak form of PPP is satisfied for compared to flexible rate period and strong of PPP is rejected for all cases stated is this study.

3.3 Interest Rate Parity

3.3.1 IRP Framework

IRP is important macroeconomic model which were first developed by M. J Keynes in 1923, it is an essential key to relate foreign exchange market with foreign exchange rate and spot exchange rate, in other words it is an equation that connect currency exchange rate with interest rate.

IRP is defined as a benchmark for capital mobility between markets it is the concept of no-arbitrage in the foreign currency market, its goal is that an investor care unable to lock on the current exchange rate in one currency for a low price and then purchasing a distinct perspective currency from a country providing an elevated price for interest, its basic premise is that minimized risk on returns in different currency should be the same rather than their interest rate (Erdemlioglu, 2008).

The concept of no-arbitrage stresses on the fact that the differential between interest rates of two different currencies will be equal to the size of forward discount and premium on a foreign currency of the countries in comparison, when the relationship parity holds meaning that if the no-arbitrage condition is satisfied the forward contract agreed on to minimize the risk against currency fluctuation is said to be ''Covered interest rate parity''.

The formula of IRP is below:

$\rho = (A-V)/V = bh-bf$

Where:

- V = one unit of international currency at a spot rate in currency

- bh =domestic country interest rate

- bf = overseas country interest rate

- ρ = Discount forward or premium discount

- A = one unit of international currency at a forward rate in domestic currency

Let's provide an example to understand the interest rate parity in which we will take two cases of study one is international while the other is domestic investment, and let's assume that in both cases we have 5000$ to invest:

- **Case 1:Domestic investment**

The spot exchange rate between USD and TL is 20,45TL/1USD, in Türkiye.

SO 5000$=102250 TL, we can invest this money at rate of 2%for 1 year which yields 104295 TL at the end of the year.

- **Case 2:international investment**

If the exchange rate for 1 year is 6%,

For 5000$ of 6% interest in 1 years=5300$

Let's assume that the exchange rate is 20TL/1$, since we need to convert our 5000$ back in local currency,

5300$ to 20 TL exchange rate =106000 TL

We can conclude that, there's no arbitrage because the return of investment is the same .As we said before arbitrage is a sort of activity that investors use in order to gain profit with the lowest risk by buying assets at one financial market and selling it at a premium on another.

Covered interest rate parity(CIRP) nullify the spot exchange rate and the forward premium or discount exchange rate of two different currencies, so that the investors could not earn an arbitrage profit, which means that IRP condition is satisfied, otherwise if there's an imbalance or there's a disequilibrium between bid-ask spreads then an opportunity arbitrage will appear thus covered interest arbitrage will consist of four simultaneously market, In order to establish if an appropriate combination of transactions may produce an instant and risk-free profit, the arbitrager meticulously assesses the current exchange and interest rates in various markets (Deardorff, 1979).

Let's provide an example to understand to covered interest rate parity, let's assume that Apple Company wants to pay salaries of their employees in Europe in Euros in 1 month. Apple will buy Euros in a forward contract for 1 month, after that they can invest money in dollar and then convert it to Euro for a one month period, thus no fluctuations risk in this month could affect their investment, which is seen as Covered (Erdemlioglu, 2008).

Uncovered interest rate parity (UIP) on the other hand, is contradictory to CIRP because there's no forward contract used to reduce the risk of exchange volatility of the currency, moreover The IRP is said to be ''uncovered'' due to investor 's behavior.

Let's provide an example for the UIP theory, an investor chooses to buy currencies from another country than his home country in which the foreign country provide a low interest rate, this is a form of arbitrage in which the investor's uses to generate profit ,how? Let's explain it: the investor chooses to be uncovered the fluctuation of a currency because he already traded his money that he invested to have a higher interest rate, we have to mention that if there's no contracts in the

trade the UIP will not hold in reality and it would be speculation (Alper, Ardic & Fendoglu, 2009).

3.4 Consumer Price Index

CPI or frequently called conditional cost-of-living index is a measure of prices of commodities and goods (food and beverages, services, medical care, transportation, education, registration fees and other goods) that could change overtime due to the inflation's annual value and it is also considered as upper bound on a cost-of-living index , we have to mention that CPI doesn't take into account security and incomes taxes in other way CPI exclude taxes that are not associated to the buy of goods and services and it is accomplished by conducting surveys to a typical household by average market basket .

CPI can be used in different ways, firstly it can be used as a form of adjustment of currency's exchange rate by mean of adjustments in federal income tax structure to prevent increase of inflation rate, and secondly it can be used as an economic indicator that provides information about changes in a country's economy and help in the decision making of government's economic policies for example the FED uses CPI's trend to formulate fiscal and monetary policies, thirdly it can be used as deflator of other economic series for adjustments which can include retail sales, components of national income and earnings of labors weekly and hourly however CPI also can used as a deflator of the value of the consumer's currency to find its PPP, which means if *prices increases the PPP decline* (Bryan, & Cecchetti, 1993).

CPI is set conventionally by 100 for the base year, if the cost of a market basket rise the CPI could rise above 100 and vice versa, also we have to mention

that CPI measures the average of quantities of goods and services which means that if the CPI increases it doesn't directly lead to a rise of all prices, because some other goods may decline and that's why we made it clear before that CPI is an average measurement (Boskin, et al., 1998).

The PPP's exchange rate and CPI relationship is valid with some small adjustments, the example below will simplify this correlation moreover for this formula to work correctly we choose the same base year between USA and Türkiye:

1-let's assume the 2009 ratio between USA and Türkiye

$$\frac{CPI\ 09(tl)}{CPI\ 09(\$)} = \frac{\frac{CB\ (tl\ 09)}{CB\ tl\ (08)}}{\frac{CB\ \$\ (09)}{CB\ \$\ (08)}} = \frac{CB\ tl\ 09}{CB\ \$\ 09} * \frac{CB\ \$08}{CB\ tl\ 08} = \frac{\frac{CB\ tl\ 09}{CB\$\ 09}}{\frac{CB\ tl\ 08}{CB\ \$\ 08}}$$

2-the base year is 2008, we will divide PPP exchange rates in 2009 by PPP exchange rate in 2008.

$$\frac{CPI\ 09(tl)}{CPI\ 08(\$)} = \frac{\frac{CB\ (tl\ 09)}{CB\ \$(09)}}{\frac{CB\ tl\ (08)}{CB\ \$\ (08)}} = \frac{E^{tl}/_{\$}(ppp)\ 09}{E\ ^{tl}/_{\$}(ppp)08}$$

3-PPP's exchange rate will be equal by using CPI in the formula as 2008 is the base year.

$$E\ ^{tl}/_{\$}\ (ppp)09 = E\ ^{tl}/_{\$}\ (ppp)08 * \frac{CPI\ tl\ 09}{CPI\ \$\ 09}$$

CPI 09 (Tl): consumer price index in 2009 of Türkiye in Turkish lira

CPI 09 ($): consumer price index in 2009 of USA in US dollar

CPI 08 (Tl): consumer price index in 2008 of Türkiye in Turkish lira

CPI 08 ($): consumer price index in 2008 of USA in US dollar

CB 08 (Tl): costs of Basket in 2008 in Turkish lira

CB 09 (Tl): costs of Basket in 2009 in Turkish lira

CB 08 ($): costs of Basket in 2008 in US dollar

CB 09 ($): costs of Basket in 2009 in US dollar

09 and 08: 2009 and 2008 period

$E\,^{tl}/_{\$}\,(ppp)$09: PPP exchange rate in 2009 between Turkish lira and US dollar

$E\,^{tl}/_{\$}\,(ppp)$08: PPP exchange rate in 2008 between Turkish lira and US dollar

3.5 Inflation

Inflation can be defined as the increase in prices of goods and services or increase in a cost of market basket, CPI and PPI are indexes to measure inflation, three different types of inflation exists the first is demand pull the second is cost put inflation and the third is built-in, often expressed in percentage, inflation is related to PPP and IRP (Ho, 2005).

In the first hand inflation could have a significant on the PPP which means that a customer could not buy the same items with same amount of money due to rise in prices which directly means that the PPP declines when inflation starts, the

opposite of inflation is deflation and that occurs when prices of commodities begin to drop and then the PPP will increase, while on the hand IRP parity has a reversible impact on inflation, we can see nowadays in 2023 that inflation is getting higher and higher in every quarter and the only way to stop the leak and to protect the PPP of customer is to increase interest rate on bonds and loans from central banks to maintain stability of prices in the stock market, moreover when inflation rise exchange rates become too volatile and the expectation are far from the usual (Abdurehman & Hacilar, 2016).

Inflation has a direct correlation with PPP exchange rates because some nations if we take the example of the USA, the dollar is the first reserve currency in the world which makes USD always reaching new peaks and always strong comparing to the other nations such as Türkiye, Europe area, United Kingdom and others, also other parameters would make PPP exchange rates in the USA much stable is the unemployment rate in which we can see that the USA is making good in that matters offering more jobs and making the PPP more stable and the reasons why inflation could happen are many but we will state some of them such as the increase of supply of money which is a traditional but during this period of 2020-2022 we had COVID-19 which made a kind of break in the international worldwide economy which is seen as the main factor of inflation moreover the post COVID-19 we are seeing a big war in the east of Europe between Russia and Ukraine which had a crucial influence on the stock market by the increase in raw materials, oil industry which represents 40% of the world largest banks in the world, Thus inflation was just a matter of time after the pandemic.

Inflation differential is an indicator that could help us understand the variations of the PPP exchange rates and the impact of IRP between two nations,

this latter it is viewed as the difference of level of inflation between two countries which have a direct impact on exchange rates, let's assume that inflation rate in the USA is 8% while in Türkiye inflation rate is 22%, this will have a significant impact on the value of currency because when inflation rates are high a depreciation is on the arisen, that's what we are seeing nowadays after the release of documents from the CBRT about the inflation and interest rate, we have seen Turkish lira depreciating, however the policies made by Turkish government was seen as disastrous because while the FED is increasing interest rates every quarter in this year by 25 point, Türkiye on the other hand is lowering interest rates or leaving the same rate which will result to high depreciation in Türkiye 's currency and loss of PPP. The CBRT policies have led Türkiye 's economy to struggle because PPP exchange rates are far from the usual and every day we are seeing a loss in Türkiye currency and devaluation that could lead to higher inflation and a larger difference on PPP exchange rate, Thus interest rates and PPP exchange rates correlates with inflation and of course there are other parameters related to them such as economic growth, consumer spending, the level of debt of the country, foreign investment and finally the balance of trade.

CHAPTER 4

DATA AND METHODOLOGY

4.1 Data Collection

The relative PPP and inflation in Türkiye is a good case of study, the CBRT's new policies have made the financial institutions to be crucial especially after the freely floating regime exchange rate in 2002 and the inflation targeting commitment. The data gathered will give us the opportunity to make calculation for the PPP exchange rate between USD and TL also to run the regression analysis for the exchange rates for inflation differential and secondly we will see the impact of deviations stemming from the exchange rates in Türkiye and USA.

The TL/USD exch. Rate provides a vital piece of information for the investigation's assessment. The time frame of this analysis runs from 2011 to 2022, in this project we will focus on the last 11 years. We used monthly data.

The data consists of the foreign and domestic exchange rate of the TL/USD, inflation rate and Consumer price index (CPI) of Türkiye and USA respectively. The monthly exchange rate data have been obtained from the Federal Reserve economic data (FRED) from the case of Türkiye as treasurer interest rate which will be the same for the USA.CPI (consumer price index) and PPI (producer prices indices) are indices that will aid in our evaluation for rates of inflation that are sufficient for the relative P.P.Parity, both indices encompasses prices of goods and the PPI is not as efficient than the share of goods that aren't traded, in our calculation of the implied PPP we will focus more on CPI due to the availability of data in this matter.,

4.2 Methodology

The methodology section consists of two major parts, in the first place we will compute the implied exchange rates parity regarding the PPP, while in the second place we will compare the values of implied exchange rates with real ones by running a regression analysis.

4.2.1 Calculating Implied Exchange Rate for the TRY and USD

Within this scope of this study, implied TL/USD exchange rates are calculated that is related to relative PPP based on the inflation rates of the USA and Türkiye and TL/USD exchange rate for the month chosen respectively.

The relative PPP calculate the expected USD/TL rate of conversion at time t+1 by using the amount of inflation and the actual TL/USD exchange rate at time t. The actual TL/USD exchange and inflation rates for Türkiye and USA are used to calculate the relative PPP. In the next two section we will provide explanations regarding the calculation of this theory, more over will compare actual exchange rates with implied one.

4.2.1.1 Relative PPP Implied Exchange Rate Assessment for the TRY and USD

The relative PPP formula is below:

(PPP Implied TL/USD) $_{t+1}$ = $((1+i_{USA})_{t+1} / (1+i_{TR})_{t+1}) * (TL/USD)_t$

Where:

i $_{(USA)}$: USA inf.rate

i($_{TR}$): Türkiye inf.rate

t= time

As an example, we calculate the PPP implied exchange rate for as follows:

We'll require to compute the relative PPP implied exchange rate TL/USD:

- TL/USD exchange rate in 202018,65---0,66

- Inflation rate for Türkiye in 2021= 8%=0,08

- Inflation rate in the USA in 2021=72,3%=0,723

Implied PPP= ((1+0, 08)/ (1+0,723)* (18.65) $_{2021}$

4.2.2 Regression Analysis

The calculation of the PPP implied TL/USD and the data gathered for the actual exchange rate TL/USD will help us to compare their values, and the relative PPP states that the actual exchange rate TL/USD is in fact a change in price levels in Türkiye and the USA, thus the equality of PPP implied exchange rate TL/USD and the actual ones.

In order to run a regression analysis, the PPP implied TL/USD would be equal to the actual TL/USD exchange rate by using Microsoft excel computer program, we will take in consideration two variables, the first is PPP implied TL/USD as a dependent variable and the second is the actual TL/USD exchange rates as independent variable (Berberoglu, 2004).

Regression analysis must first confirm the stationarity of the data series before it can evaluate the PPP theory, in other words we need to make sure that the information we utilize for *unit root test is valid for the regression analysis.* The non-dependency of rate of exch. at time t-1 and t if must hold if the data available contain unit roots. One of the fundamental presumptions of regression analysis is broken by this data reliance. Therefore when there is a unit root, estimated

regression coefficients are skewed. We execute the following regression models to look for *unit root:*

- $$Z(t) = M + c. \, Z \, (t-1) + Σ(t)$$

With:

- B(t)   : time t of real dollar TL/USD rate of conversion

- E(t-1)   :time t-1 real dollar TL/USD rate of exchange

- Σ(t)   : Error term

- $$Q(t) = c + d. \, Q(t-1) + δ(t)$$

With :

- Q(t) : Parity implied t TL/USD exchange rate

- Q(t-1) : t-1 Parity implied TL/USD exchange rate

- δ(t) : Error term

We use the corresponding values from time t-1 to regress the values of e and q at the time t. The (b and d) and the (c and a) are the coefficients of the regression and they must be equal to one and different from zero respectively if there is unit root. Regarding the regression constant (a and c) we will see if they are not equal to 0, and for the constant (b and d) if they are equal to 1, in our hypothesis we will in consideration α as a significance level of 95%.

The literature on exchange rates suggests that the data on the exchange rate itself have a unit root, as a result we anticipate discovering unit root in our data as well, moreover we need to solve the unit root test problem in order to statistically

evaluate the equality between the PPP implied TL/USD exchange rate and the actual TL/USD exchange rate.

Employing the ''first differences'' is the most typical way to solve the unit root test problematic, at time t and t -1 exchange rates are reliant on the exchange rate at time t-1 if the problem exists, this indicate that the regression analysis constants (a and c) and (b and d) are equal to 0 and 1 respectively. This will give us the ability to write a new regression line as follow:

- $E(t) = E(t-1) + \xi(t) \implies E(t)-E(t-1) = \xi(t)$

- $Q(t) = Q(t-1) + \delta(t) \implies Q(t)-Q(t-1) = \delta(t)$

We need to investigate the availability of the unit root from the data of the first differences to guarantee the unit test removal. The following equation must be taken into account:

- $\xi(t) = k + f. \xi(t-1) + \mu(t)$

In which:

- $\xi(t)$: first differences of the actual exchange rate TL/USD at time t
- $\xi(t-1)$: first differences of the actual exchange rate TL/USD at time t-1
- $\mu(t)$: Error term

$$\theta(t) = g + h. \delta(t-1) + \theta(t)$$

Where:

- $\theta\,(\,t\,)$: first differences of the PPP implied rate TL/USD at time t

- $\delta(\,t\text{-}1\,)$: differences of the PPP implied exchange TL/USD at time t-1

- $\theta(\,t\,)$: Error term

The values of ξ and δ at time t on their respective values at time t-1 must be regressed, in the equations mentioned earlier we have to determine if the regression constants are analytically equal to one and different from zero, in order to control whether the unit root problem is eliminated by taking the initial differences.(k and g) and (f and h) must be $\neq 0$ and equal to 1 respectively, if the two constant (f and g) and (f and h) are equal to 0 and $\neq 1$ respectively then there is a unit root problem, we will have to use a second differences however the research indicates that the first differences way eliminate the unit root problem.

We have mentioned that the data become stationary after statistically verifying that the unit root test issue has been removed from the data, thus we may conduct a regression analysis to determine the interchangeability of the implied PPP and the real values of the TL/USD exchange rates, we should highlight at time that we are using the initial deviations between the implied PPP and actual exchange rate data, the formula of our last regression is below:

- $\Omega(t) = \mu(0) + \mu(1).\xi(t) + \breve{\mathrm{z}}(t)$

Where:

- Ω (t) : PPP implied TL/USD differences rate at time t

- ɤ(t) :Real TL/USD differences exchange rate at time t

- ǯ (t) : Error term

Utilizing all the aforementioned equations, we will test this hypothesis one time for the actual and the PPP implied TL/USD exchange rate and their relationship using the data range January 2015 to January 2022, in the next chapter the findings of the empirical studies used to support this theory are presented and interpreted .

CHAPTER 5

RESULTS AND INTERPRETATIONS

Within the scope of this study the result of the analysis undertaken are presented in this chapter, along with general summary of the findings, Our results and discussion will be segmented on three parts:

1.   The relative PPP and actual rates results
2.   The regression analysis
3.   A broad descriptions of the findings

5. 1 Results Related to PPP Implied and Actual Exchange Rates

The results concerning the PPP implied TL/USD exchange rate and the actual one are presented on the figure below as an excel sheet, based on the interest rate from 2015 to 2022 beginning of the year.

Table 2

Results of the PPP Implied and Actual Exchange Rates for TL/USD

date	USA inf.rate %	Türkiye Inf.rate	Exch.rate USD/TL	Türkiye inf.rate in %	ppp implied exch.rate usd/tl
2015-01-01	-0,09	1,1	2,334	0,01	
2015-02-01	0,11	-9,0	2,462	-0,09	1,917
2015-03-01	0,05	-7,4	2,591	-0,07	2,178
2015-04-01	0,10	0,0	2,654	0,00	2,363
2015-05-01	0,01	5,3	2,646	0,05	2,775
2015-06-01	0,00	0,0	2,705	0,00	2,645
2015-07-01	-0,05	-3,8	2,699	-0,04	2,725

2015-08-01	-0,21	5,3	2,854	0,05	3,594
2015-09-01	-0,09	8,8	3,011	0,09	3,406
2015-10-01	-0,02	6,9	2,926	0,07	3,298
2015-11-01	0,07	2,2	2,874	0,02	2,788
2015-12-01	-0,06	2,1	2,920	0,02	3,107
2016-01-01	-0,10	-1,0	3,007	-0,01	3,193
2016-02-01	-0,11	1,0	2,943	0,01	3,424
2016-03-01	0,24	-2,1	2,888	-0,02	2,317
2016-04-01	0,06	-2,1	2,836	-0,02	2,660
2016-05-01	-0,02	-5,4	2,938	-0,05	2,740
2016-06-01	-0,12	-1,1	2,917	-0,01	3,317
2016-07-01	0,00	1,1	2,956	0,01	2,963
2016-08-01	0,00	-3,4	2,963	-0,03	2,847
2016-09-01	0,05	-9,4	2,964	-0,09	2,565
2016-10-01	0,15	-7,8	3,076	-0,08	2,372
2016-11-01	0,16	1,4	3,285	0,01	2,700
2016-12-01	0,11	6,9	3,497	0,07	3,154
2017-01-01	0,08	6,5	3,750	0,06	3,461
2017-02-01	0,01	8,5	3,667	0,09	4,040
2017-03-01	-0,02	9,0	3,670	0,09	4,090
2017-04-01	-0,09	3,1	3,653	0,03	4,157
2017-05-01	-0,07	-2,0	3,568	-0,02	3,847
2017-06-01	-0,11	-1,0	3,520	-0,01	3,960
2017-07-01	0,04	2,1	3,563	0,02	3,443
2017-08-01	0,00	5,1	3,509	0,05	3,730
2017-09-01	0,06	7,7	3,474	0,08	3,571
2017-10-01	0,03	6,3	3,676	0,06	3,591
2017-11-01	0,00	3,4	3,890	0,03	3,816

Date					
2017-12-01					
	0,04	0,8	3,843	0,01	3,764
2018-01-01					
	0,14	-3,2	3,775	-0,03	3,250
2018-02-01					
	0,06	-2,5	3,784	-0,03	3,480
2018-03-01					
	-0,01	-3,4	3,891	-0,03	3,695
2018-04-01					
	0,04	7,1	4,061	0,07	4,017
2018-05-01					
	0,01	5,8	4,421	0,06	4,236
2018-06-01					
	-0,02	14,8	4,637	0,15	5,203
2018-07-01					
	0,00	4,1	4,768	0,04	4,843
2018-08-01					
	-0,02	15,7	5,883	0,16	5,600
2018-09-01					
	0,02	37,3	6,345	0,37	7,887
2018-10-01					
	-0,01	0,4	5,833	0,00	6,447
2018-11-01					
	-0,11	-15,6	5,363	-0,16	5,517
2018-12-01					
	-0,19	-4,9	5,317	-0,05	6,281
2019-01-01					
	-0,02	-3,6	5,367	-0,04	5,245
2019-02-01					
	0,08	-5,3	5,272	-0,05	4,694
2019-03-01					
	0,04	-3,4	5,462	-0,03	4,918
2019-04-01					
	0,02	-6,9	5,760	-0,07	4,965
2019-05-01					
	-0,11	-3,1	6,047	-0,03	6,273
2019-06-01					
	-0,13	-7,1	5,819	-0,07	6,433
2019-07-01					
	0,05	9,0	5,668	0,09	6,023
2019-08-01					
	-0,17	-17,7	5,632	-0,18	5,594
2019-09-01					
	0,00	-44,6	5,710	-0,45	3,117
2019-10-01					
	-0,03	-9,7	5,791	-0,10	5,293
2019-11-01					
	0,08	38,5	5,738	0,38	7,428
2019-12-01					
	0,08	6,7	5,852	0,07	5,680
2020-01-01					
	0,00	5,2	5,926	0,05	6,139
2020-02-01					
	-0,11	3,0	6,063	0,03	6,819
2020-03-01					
	-0,63	4,8	6,336	0,05	17,126

Date					
2020-04-01	0,12	-2,8	6,850	-0,03	5,518
2020-05-01	0,01	4,7	6,932	0,05	7,087
2020-06-01	0,16	10,8	6,816	0,11	6,635
2020-07-01	0,18	-8,1	6,865	-0,08	5,293
2020-08-01	0,21	10,6	7,262	0,11	6,302
2020-09-01	-0,01	1,6	7,534	0,02	7,417
2020-10-01	0,05	1,6	7,918	0,02	7,305
2020-11-01	0,01	14,0	7,986	0,14	8,948
2020-12-01	0,20	5,4	7,712	0,05	6,995
2021-01-01	0,17	7,1	7,397	0,07	7,085
2021-02-01	0,10	2,4	7,081	0,02	6,897
2021-03-01	0,10	3,5	7,677	0,04	6,694
2021-04-01	0,07	3,4	8,163	0,03	7,389
2021-05-01	0,12	-3,8	8,357	-0,04	7,018
2021-06-01	-0,13	2,9	8,613	0,03	9,826
2021-07-01	-0,02	-2,8	8,590	-0,03	8,502
2021-08-01	0,02	-6,3	8,474	-0,06	7,884
2021-09-01	0,00	3,0	8,546	0,03	8,770
2021-10-01	0,19	-1,2	9,193	-0,01	7,092
2021-11-01	0,08	6,6	10,690	0,07	9,064
2021-12-01	0,36	79,8	13,558	0,80	14,154
2022-01-01	0,20	23,1	13,535	0,23	13,901

Note: The Table represents the PPP Implied Exchange Rates during the period 2015-2022, Retrived as a source from the Federal Reserve Economic Data (FRED), and its frequency is Monthly.

The table 5.1 represents the results of PPP implied exchange rates TL/USD and the actual TL/USD one from 2015 through 2022.The formula of PPP implied

dollar to Turkish lira was treated in the anterior chapter ,in which there's a relationship between this latter and the actual TL/USD exchange rate.

All the results provided in the precedent section demonstrate that the relative PPP exchange rates do not significantly vary from the actual ones. To assume that the PPP theory applies to the dollar to Turkish lira exchange rate without first ensuring that the time series data is stationary would be deceptive, the fluctuation of the implied purchasing power parity and actual rate explains the presence of unit root in our exchange rate so closely.

The literature study on exchange rate noted in chapter four; we are likely to uncover unit roots data as well. At this point it is possible to conclude that the real exchange rate and parity exchange rates indicated in analytical representation may suggest that our exchange rate data as unit roots.

An analytical presentation given provides information on the strength on the link between the implied PPP and the actual TL/USD exchange rates respectively, despite the regression analysis for this parity are done to quantitatively demonstrate the power of this relationship. The following goes after the regression findings.

5.2 Regression Results

In the parity exchange, we attempt to assess whether this latters are equal to the real ones using various assumptions in the previous chapter, but because our data are exchange rates, we first check to see if they are stationary. We must conduct a regression analysis to test stationarity of the values of actual and parity implied exchange rates at time t on their respective values at time t-1, we must conduct a regression analysis.

The tables 5.2 and 5.3 consists on the nonstationarity of the data, in which we made some calculations to prove that unit root test holds, the tables below shows the calculations of the differenced PPP implied and actual differenced (TL/USD exchange rate respectively.)

Table 3

Results of the Differenced PPP Implied Exchange Rates TL/USD from 2015 to 2022

Date	ppp Implied Exchange Rate TL/USD	Differenced ppp Implied Exchange Rate TL/USD
2015-03-01	2,352	0,261
2015-04-01	2,489	0,185
2015-05-01	2,635	0,412
2015-06-01	2,544	-0,131
2015-07-01	2,981	0,080
2015-08-01	3,713	0,869
2015-09-01	3,348	-0,188
2015-10-01	3,152	-0,108
2015-11-01	2,787	-0,511
2015-12-01	3,011	0,319
2016-01-01	3,260	0,087
2016-02-01	3,319	0,231
2016-03-01	2,316	-1,107
2016-04-01	2,571	0,344
2016-05-01	2,863	0,080
2016-06-01	3,394	0,577
2016-07-01	2,830	-0,354
2016-08-01	2,670	-0,116
2016-09-01	2,610	-0,283
2016-10-01	2,609	-0,193
2016-11-01	2,848	0,328
2016-12-01	3,141	0,454
2017-01-01	3,528	0,307
2017-02-01	4,057	0,579
2017-03-01	3,869	0,049
2017-04-01	3,952	0,067
2017-05-01	3,886	-0,310
2017-06-01	4,083	0,113
2017-07-01	3,544	-0,517

2017-08-01	3,823	0,287
2017-09-01	3,523	-0,159
2017-10-01	3,493	0,020
2017-11-01	3,722	0,225
2017-12-01	3,613	-0,052
2018-01-01	3,275	-0,514
2018-02-01	3,447	0,229
2018-03-01	4,097	0,216
2018-04-01	3,969	0,322
2018-05-01	4,599	0,218
2018-06-01	4,716	0,967
2018-07-01	5,382	-0,361
2018-08-01	6,646	0,758
2018-09-01	5,768	2,286
2018-10-01	5,420	-1,440
2018-11-01	6,217	-0,930
2018-12-01	6,366	0,765
2019-01-01	5,151	-1,036
2019-02-01	4,790	-0,551
2019-03-01	4,736	0,225
2019-04-01	5,169	0,046
2019-05-01	6,018	1,308
2019-06-01	7,542	0,160
2019-07-01	4,548	-0,410
2019-08-01	3,766	-0,429
2019-09-01	5,081	-2,477
2019-10-01	8,118	2,175
2019-11-01	5,722	2,135
2019-12-01	5,602	-1,748
2020-01-01	6,009	0,459
2020-02-01	6,941	0,680
2020-03-01	15,890	10,307
2020-04-01	5,942	-11,607
2020-05-01	7,500	1,569
2020-06-01	5,501	-0,452
2020-07-01	6,373	-1,343
2020-08-01	5,788	1,009
2020-09-01	7,415	1,115
2020-10-01	8,195	-0,113
2020-11-01	8,280	1,643
2020-12-01	7,105	-1,953
2021-01-01	6,775	0,091
2021-02-01	6,972	-0,189

2021-03-01	6,686	-0,203
2021-04-01	6,871	0,695
2021-05-01	7,507	-0,371
2021-06-01	9,288	2,808
2021-07-01	8,195	-1,324
2021-08-01	8,669	-0,618
2021-09-01	8,410	0,886
2021-10-01	7,650	-1,678
2021-11-01	15,289	1,973
2021-12-01	15,629	5,089
2022-01-01	13,676	-0,253

We attempt to assess whether the PPP suggested rates are equal to the real rates using assumptions from the previous chapter, but because our data are exchange rates, we first check to see if they are stationary. To test stationarity, values must be regressed for actual and ppp implied exchange rates at time t on their respective values at time t-1.

Table 4

Results of the Differenced Actual TL/USD Exchange Rates during the Period 2015-2022

Date	Actual Exchange Rate TL/USD	Differenced Actual Exchange Rate TL/USD
2015-03-01	2,591	0,129
2015-04-01	2,654	0,063
2015-05-01	2,646	-0,008
2015-06-01	2,705	0,058
2015-07-01	2,699	-0,005
2015-08-01	2,854	0,155
2015-09-01	3,011	0,156
2015-10-01	2,926	-0,085

2015-11-01	2,874	-0,051
2015-12-01	2,920	0,046
2016-01-01	3,007	0,087
2016-02-01	2,943	-0,064
2016-03-01	2,888	-0,054
2016-04-01	2,836	-0,052
2016-05-01	2,938	0,102
2016-06-01	2,917	-0,021
2016-07-01	2,956	0,039
2016-08-01	2,963	0,006
2016-09-01	2,964	0,001
2016-10-01	3,076	0,111
2016-11-01	3,285	0,209
2016-12-01	3,497	0,211
2017-01-01	3,750	0,253
2017-02-01	3,667	-0,083
2017-03-01	3,670	0,003
2017-04-01	3,653	-0,017
2017-05-01	3,568	-0,084
2017-06-01	3,520	-0,048
2017-07-01	3,563	0,043
2017-08-01	3,509	-0,054
2017-09-01	3,474	-0,035
2017-10-01	3,676	0,201

2017-11-01	3,890	0,214
2017-12-01	3,843	-0,046
2018-01-01	3,775	-0,068
2018-02-01	3,784	0,008
2018-03-01	3,891	0,107
2018-04-01	4,061	0,169
2018-05-01	4,421	0,359
2018-06-01	4,637	0,216
2018-07-01	4,768	0,130
2018-08-01	5,883	1,114
2018-09-01	6,345	0,462
2018-10-01	5,833	-0,511
2018-11-01	5,363	-0,469
2018-12-01	5,317	-0,046
2019-01-01	5,367	0,050
2019-02-01	5,272	-0,095
2019-03-01	5,462	0,189
2019-04-01	5,760	0,298
2019-05-01	6,047	0,286
2019-06-01	5,819	-0,227
2019-07-01	5,668	-0,151
2019-08-01	5,632	-0,035
2019-09-01	5,710	0,077
2019-10-01	5,791	0,081

2019-11-01	5,738	-0,053
2019-12-01	5,852	0,114
2020-01-01	5,926	0,073
2020-02-01	6,063	0,136
2020-03-01	6,336	0,273
2020-04-01	6,850	0,514
2020-05-01	6,932	0,081
2020-06-01	6,816	-0,115
2020-07-01	6,865	0,048
2020-08-01	7,262	0,397
2020-09-01	7,534	0,271
2020-10-01	7,918	0,383
2020-11-01	7,986	0,068
2020-12-01	7,712	-0,273
2021-01-01	7,397	-0,314
2021-02-01	7,081	-0,315
2021-03-01	7,677	0,595
2021-04-01	8,163	0,486
2021-05-01	8,357	0,193
2021-06-01	8,613	0,256
2021-07-01	8,590	-0,022
2021-08-01	8,474	-0,116
2021-09-01	8,546	0,071
2021-10-01	9,193	0,647

2021-11-01	10,690	1,496
2021-12-01	13,558	2,867
2022-01-01	13,535	-0,022

We can conclude from this table 5.3 that the values of the actual TL/USD exchange rate are very different from the differenced PPP implied TL/USD exchange rate, to show nonstationarity of our data, which means that there's no unit root.

The tables 5.2 and 5.3 consists on the nonstationarity of the data, in which we made some calculations to prove that unit root test holds, the tables show the results of differenced PPP implied TL/USD exchange rate, and differenced actual TL/USD exchange rate. These data and results will gives us the opportunity to run the regression analysis and comment its value to conclude whether this theory holds or not. We can see that on the table 5.1

The tables 5.4 below shows the regression analysis and have two parts that consists of, summary output and Anova. To prove the nonstationarity of the data we have to check first the adjusted R square in which its range should be higher than 60% by using first differences and to have result of adjusted R square we have to multiply the results on the table by 100 to get a percentage.

The significance of F statistics is one of the most essential tools or parameters that is crucial in determining the overall significance of the model.it Null hypothesis is P value is greater than 0,05 for linear relationship and the second is the alternative hypothesis for nonlinear relationship in which P is lower than 0,05. The F statistics shows that overall the model is significant.

The table below is the regression analysis made the MS Excel, that provides various results and data about the differenced PPP implied TL/USD exchange rate and the differenced actual TL/USD exchange rate, it will confirm the relationship between those two and the essential role of each of these parameters on the results that we will interpret in the next part.

Table 5

Regression Analysis for the Differenced PPP Implied TL/USD Exchange Rates and Actual Exchange Rates TL/USD (2015-2022)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,266
R Square	0,071
Adjusted R Square	0,059
Standard Error	1,972
Observations	82,000

ANOVA

	df	SS	MS	F	Significance F
Regression	1,000	23,775	23,775	6,112	0,016
Residual	80,000	311,200	3,890		
Total	81,000	334,975			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0,031	0,229	-0,134	0,894	-0,486	0,425	-0,486	0,425
Actual exchange rate	1,300	0,526	2,472	0,016	0,254	2,347	0,254	2,347

The independent variable (Y) represents differences of the implied Purchasing. P. P TL/USD exchange rate and the dependent variable (X) depicts the rate of actual differences TL/USD, as we mentioned earlier that the nonstationarity problem is cancelled, we can analyze whether the PPP implied and actual exchange rate of TL/USD are equal or not.

The equation is as follow: $Y = \alpha + \beta\ EXC$

α : Constante or Intercept

β: coefficient of actual differenced TL/USD exchange rate

When we computed this equation we found that the parity theory between the PPP TL/USD implied exchange rate and actual differenced TL/USD exchange does not hold ,because there's a significant variation between the two variables in which we can conclude that for a short period which is in our case eight years, the US dollar and Turkish lira relationship does not hold ,moreover if we take a long period of time maybe the values can be less significant a maybe the relationship can hold but not necessarily because the economies of these two nations are very different because the USA is first worldwide economy and Türkiye is twentieth which means that differences will appear and the relationship between the two currencies may or may not hold.

We can see in our table that the significance F is 91, 8% and F values are greater than 2, 9 since all the section have P values lower 0, 0091 which is less than 5% significance level, moreover the adjusted R square values are 23, 1% which means that there's no unit root and the dependency between the actual differenced TL/USD exchange rate and the differenced PPP implied TL/USD exchange rate doesn't really holds.

Figure 2

Differenced rate of PPP implied TL/USD scatter plot and differenced actual TL/USD rate (2015-2022)
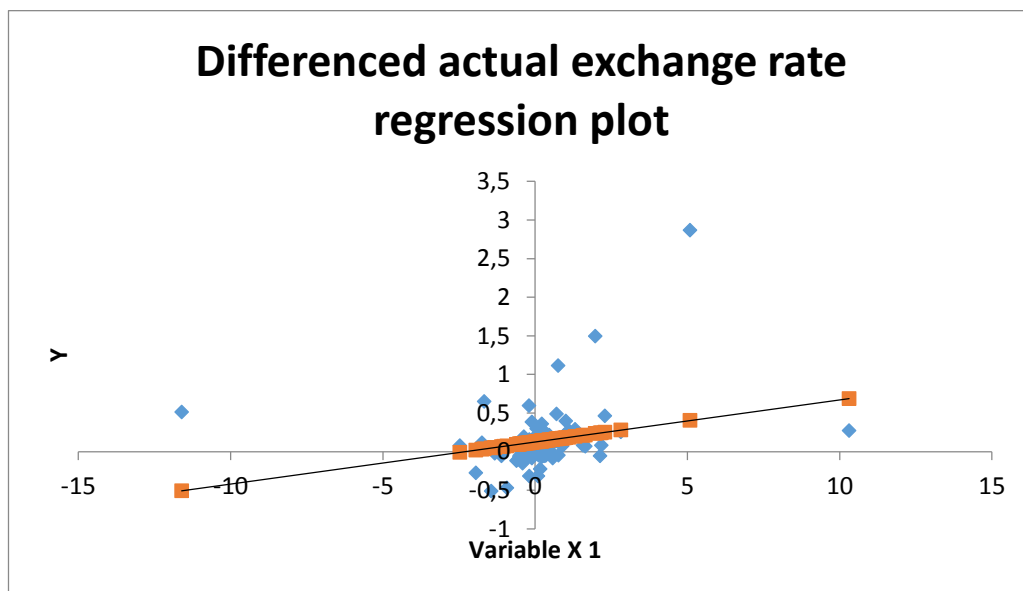
The graph of the scatter and the regression slope, is shown as a deviation line in the graph 5, demonstrated in the illustration actual differenced TL/USD rate at time t does not differ much from the exchange rate at time t-1, which means that actual TL/USD rate at t is not independent from actual TL/USD at t-1, in other words it has unit root. While if we compare the differenced PPP implied TL/USD exchange rate data with the actual ones, it ought to be highlighted that at t actual rate compared with the implied rate at time t of these differences vary greater than the normal ones, which means that the differences values. Thus we can conclude that the alternative hypothesis holds and there's a linear relationship between the differenced TL/USD exchange rate and the differenced actual ones.

5.2 A Broad Description of the Findings

Our analysis's overall statistical conclusions are consistent with the empirical evidence supporting the theories of PPP and IRP, Our findings are explored in the forthcoming article with the regard to the hypothesis paragraphs.

Regarding the relative purchasing power parity hypothesis as we already indicated, the bulk of research provide evidence that exchange rate eventually return to their PPP values and momentary departures from the purchasing power.P are substantial variable. However the foreign currency trade takes really long for adaptations of PPP deviations, this study examines the monthly data of the TL/USD exchange rates over an 8 year period. Our results demonstrate that the PPP hypothesis does not also apply to this bid-ask rate, we draw the conclusion that for a higher length of time the P.power.P Parity will likely to stand for the quotation Turkish lira/USD with data, which is consistent given proof shown in the research study. Disparities in the basket of products accustomed to compute the CPI in the United States of America and republic of Türkiye might be one of the probable factors for the departures from the PPP. The data associated with Türkiye shows that inflation rate does not take household preferences from various nations into account. We may consider multiple baskets and build an entirely different composite basket out of them when calculating a composite inflation rate for Türkiye, therefore finding a similar basket of commodities between the USA and Türkiye would be exceedingly challenging. The discrepancies between the goods included and the weights assigned to them when calculating the CPI for the USA and Türkiye may be the cause of the deviations from the PPP.As per to the PPP study material, increase in prices is not the sole variables that drives exchange rates, which suggest that may be a further reason for the PPP's deviations.

Other factors may have a more expansive effect on exchange rates than price hikes, such as interest rate or income levels. The exchange rate between the dollar and Turkish lira may also support this. Exploring this matter nevertheless is outside the purview of this project, the core principal of the PPP is the prospect of ''good arbitrage'' .The designated PPP removals from our analysis can be seen gradually occurring adjustments since good market display sluggish price changes. In our connections to our findings with regards to IRP doctrine, the majority of previous studies suggests that predicted exchange rates change are required in order to effectively assess whether the interest rate parity holds, despite this in line research on revealed IRP theory, in this study real fluctuations rates would be employed as a measure of anticipated changes in rate. In reference to our findings related to IRP hypothesis, actual exchange rate movement are also employed as predictor of expected exchange rate changes in this study. This means that we assume the role foresighted investor, because exchange rate swings are constantly unpredictable, our analysis are unbalanced.

Future exchange rate volatility will always be predictable, therefore our analysis have a prejudice in terms of perfect foresight. In a nut shell given the high level of uncertainty around future exchange rates, which may be caused by how currency rates react to changes in numerous economic factors, our finding advise that the relationship between the PPP implied bid-ask TL/USD and actual TL/USD exchange rates are valid due the not stationary in unit root, moreover the coefficients shown in the regression part provides a good example of perfect relationship between the two variables(PPP implied TL/USD and actual exchange rate TL/USD).

CHAPTER 6

CONCLUSION

In this project, we examine if the relative PPP theory holds for Turkish lira/Dollar exchange rate. . Our stage of analysis spans the years 2015 through 2022, totaling 8 years monthly data. Towards the end, it is found that PPP TL/USD exchange rate are analytically not that much different from the actual TL/USD exchange rates except the last two years in which the pandemic appeared and led to the drop in economic growth and increase in price of commodities and futures after the post COVID-19.

Before evaluating the study's discoveries main flaws, this study's restrictions should be briefly discussed. The currency rate selected for the analysis is the Turkish lira/Dollar exchange rate and Turkish lira has only been in operation for 8 years which we analyzed in our project., After the tremendous economic crisis in 2001, a new Turkish lira was first established in 2005 with a Turkish Lira/Dollar exchange rate equivalent to 1$=2, 8 TL, this was after the reforms and revaluation made by the Turkish government removing six zeros from the values of the old currency (Karahan & Colak, 2012).

Another restriction of the study is in the calculation of the inflation rates. This data is gathered from the FRED (Federal Reserve economic data). The inflation rates are calculated using the Consumer price index both for the USA and Türkiye. The basket of goods and services constituting the basket used in calculating the CPI are different in two countries, which affected the exchange rate fluctuations during the period studied, moreover between 2015 and 2020 these data

were nearly the same but after the COVID-19 pandemic it changes tremendously due the drop in economic growth, lack of reserve currencies and the geopolitical conflicts.

To determine the validity of the theory, we statistically and analytically compared the parity suggested exchange rate with actual exchange rates, regression analysis was employed. We performed two regression analysis for stationarity of the data, and this regression revealed that our data had unit roots. To attempt to determine if the parity suggested Turkish lira/Dollar exchange rate analytically and statistically differ from the actual Turkish lira/Dollar exchange rate, we made use of the initial differences in the data. In line with our findings, all parity indicated TL/USD exchange rate values deviate analytically from the real exchange rate.

In conclusion the Turkish Lira/USD exchange rate does not support either the PPP or the IRP doctrines, concerning the TL/USD exchange rate, additional work remains. However time is necessary to perform more investigation on this bid-ask rate.

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