Exchange Rate Pass-Through in Turkish Republic of Northern Cyprus

Necmi Özlüoğlu

Submitted to the
Institute of Graduate Studies and Research
in partial fulfilment of the requirements for the degree of

Master of Science
In
Banking and Finance

Eastern Mediterranean University
January 2020
Gazimağusa, North Cyprus

Approval of the Institute of Graduate Studies and Research

_____
Prof. Dr. Ali Hakan Ulusoy
Director

I certify that this thesis satisfies the requirements as a thesis for the degree of Master of Science in Banking and Finance.

_____
Prof. Dr. Nesrin Özataç
Chair, Department of Banking and Finance

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Master of Science in Banking and Finance.

_____
Prof. Dr. Mustafa Besim
Supervisor

Examining Committee
_____

1. Prof. Dr. Mustafa Besim   _____

2. Assoc. Prof. Dr. Kamil Sertoğlu   _____

3. Asst. Prof. Dr. Ayşem İyikal Çelebi _____

ABSTRACT

Advancements in transportation and technology coupled with the liberalization of the trade policies across nations have led to significant growth in the volume of trade worldwide in the last several decades. Exchange rate fluctuations, which directly affect the prices of goods traded between countries, are important for the exporting and importing countries. The exchange rate pass through, which is the main focus of this study, shows how import and export goods' prices change due to exchange rate fluctuations. The collapse of the Bretton Wood, increase in the share of the developing economies trade globally, have made the topic of exchange rate pass through to become more important in the globalized world.

This research is conducted in a very small economy, Turkish Republic of North Cyprus (TRNC), who has limited trade and financial integration with the world. The thesis analyses and determines the degree of pass through in TRNC using VAR method. In this respect, monthly inflation rate, electricity price changes, and exchange rate changes from January 2000 to September 2019 was used. The study attempts to measure the impact of foreign exchange rate (Euro) changes on consumer price index (CPI) in TRNC. The result of the research finds that changes in exchange rates have significant pass through effect on the consumer price index and the ERPT effect disappears only by the fifth month. The accumulated ERPT effect on CPI was estimated to be around 35% by the fifth month. The research also found that electricity price changes affect the CPI significantly.

Keywords: Exchange rate pass through, VAR analysis, TRNC

ÖZ

Ulaştırma ve teknolojideki gelişmeler, uluslararası ticaret politikalarının serbestleştirilmesi ile birleştiğinde, son birkaç on yılda dünya çapında ticaret hacminde önemli bir büyümeye yol açmıştır. Ülkeler arasında işlem gören malların fiyatlarını doğrudan etkileyen döviz kuru dalgalanmaları, ihracat ve ithalat yapan ülkeler için önemlidir. Bu çalışmanın ana odak noktası olan döviz kuru geçirgenliği, döviz kuru dalgalanmaları nedeniyle ithalat ve ihracat mallarının fiyatlarının nasıl değiştiğini göstermektedir. Bretton Wood sisteminin çöküşü ve küresel ticarette gelişmekte olan ekonomilerin payının artışı döviz oranı geçiş etkisi konusunun globalleşmiş dünyada daha önemli hale gelmesini sağlamıştır.

Bu araştırma, dünya ile sınırlı ticaret ve finansal entegrasyona sahip olan Kuzey Kıbrıs Türk Cumhuriyeti (KKTC) gibi küçük bir ekonomi üzerinde yapılacaktır. Tez, VAR yöntemi ile KKTC'de döviz kuru geçiş derecesini analiz edecek ve belirleyecektir. Bu bağlamda, Ocak 2000'den Eylül 2019'a kadar gerçekleşen aylık enflasyon oranı, döviz kurundaki değişimler ve elektrik fiyatı değişiklikleri olarak kullanılmıştır. Bu çalışma, döviz değişiminin KKTC tüketici fiyat endeksi (TÜFE) üzerindeki etkisini ölçmeye çalışacaktır. Çalışmada döviz kuru değişikliklerinin TÜFE üzerinde önemli bir etkiye sahip olduğu ve kurun fiyat geçirgenlik etkisinin beşinci aya kadar devam ettiği tespit edilmiştir. Birikmiş geçiş etkisinin beşinci ayda toplam %35 civarında olduğu saptanmıştır. Ayrıca, elektrik fiyat değişikliklerinin TÜFE'yi önemli ölçüde etkilediği de gözlemlenmiştir.

Anahtar kelimeler: Döviz kuru geçiş etkisi, Var analizi, KKTC

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ACKNOWLEGMENT

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LIST OF SYMBOLS AND ABBREVIATIONS

AIC	Akaike Information Criterion
CPI	Consumer Price Index
ERPT	Exchange Rate Pass Through
EURO	Exchange Rate Between Euro and Turkish Lira
FX	Turkish Lira value of a Pound
HQ	Hannan–Quinn Information Criterion
LM	Lagrange Multiplier
PPI	Producer Price Index
$P^{£}_{C}$	Price of a Computer in Pound
$P^{\square}_{C}$	Price of a Computer in Turkish Lira
RPI	Retail Price Indices
SC	Schwarz information criterion
SPO	State Planning Organization
TL	Turkish Lira
TRNC	Turkish Republic of North Cyprus
USD	United States Dollar
VAR	Vector Autoregression
WPI	Wholesale Price Index

Chapter 1

INTRODUCTION

1.1 Background of the Study

In today's globalized world, where the trade between economies is at their peak levels, change in the exchange rates is a crucial subject. In the literature of international finance, change in the exchange rates and its reflection on to the prices are studied under "exchange rate pass-through" (Moffett, Stonehill, & Eiteman, 2003). Especially after 1980s where the capital accounts of most economies have been liberalized, both trade as well as capital flows have increased at high pace. The increase in the trade has brought significant benefits specially to developing economies at the cost of uncertainty in prices caused by changes in exchange rates. This issue is especially important for developing economies of whom most currencies are weak and fluctuates a lot against major hard currencies such as Unites States Dollar (USD) and Euro. In the case of Turkish Republic of Northern Cyprus (TRNC) situation is not different where Turkish lira (TL) fluctuates at high rates against major currencies.

Exchange rate is simply the ratio that shows how much units from a currency you need to pay to buy a unit from the other currency. Every considerable exchange rate movement makes people to think about what is the link between exchange rate and general level of prices of goods and services in an economy. Turkish Republic of Northern Cyprus and Turkey are both using TL which in a way makes them to be in

the Turkish Lira Zone. In the Lira Zone the exchange rate regime is free float and so the value of TL fluctuates against other currencies freely. These two economies have strong links between each other. In a small open economy such as TRNC, the exchange rate can have a potentially large impact on inflation and inflation expectations (Leigh, Rossi, 2002). So due to this explanation we can predict that exchange rate has important role on consumer price index in TRNC. The change in the exchange rates have impacts on both imported final goods prices as well as imported raw material prices which eventually affects production costs and prices.

TRNC economy is a small and isolated. Being small and isolated economy result in having no sufficient power to take action for avoiding from Turkish Lira fluctuations. Being isolated creates other lots of problems for this island country. Because of restrictions, all imports and exports are made through Turkey. So, exports are so low. Besides the imports' volumes are significantly higher than exports of the country as domestic demand cannot be met by domestic production. In addition to this, high energy costs are another big problem for the productivity of the economy (Gorgulu, 2014). High electricity prices are another problem which makes production costly and difficult. Because of low production the country's imports increase. At the end more imports for this economy, which is not able to substitute imported goods with domestic production, means more sensitive economy to the exchange rate changes.

Exchange rate pass through are in two types. First one is complete pass-through and second is partial pass-through. If all the changes in exchange rate are reflecting on the products' price or are passed on to the prices, we define it as complete pass-through. In this type of markets, market price of a product in importer economic area with different currency from exporter area is change by amount of percentage that is

same with exchange rate change. For second type of exchange rate pass-through, the effect from exchange rate change is not fully reflect on product's price and percentage change in the price is smaller than percentage change in exchange rate. This is called partial pass-through. This situation makes question on our minds like how it is possible to have smaller change amount from exchange rate change or why the prices are not reflecting all the changes? The answer is there is absorption by exporter. When a product is exported to another economy, which used different currency with depreciation, exporter does not reflect all the exchange rate changes on the selling price. Reason of it could be fewer profit margins, which are made because of exporter wants to hold quantity of sales at a high level, or less costs that are occurred because of imported input price decreases with appreciation of Turkish lira. Partial pass-through is also associated with the price elasticity of goods. It is another important concept that helps us to understand why pass-through differentiates due to specific cases.

Especially in the recent years, the value of TL has fluctuated at high rates against major currencies. This has created significant distortions in the economy, pushing prices up. Given this situation, in this thesis, we want to search about the impact of exchange rate changes on consumer prices in Turkish Republic of Northern Cyprus.

1.2 Research Question

The study aims to find how much of the inflation is actually caused by the depreciation in Turkish lira and find out, how long it takes for the change in exchange rates to reflect on to the consumer prices. The research questions are:

- How much of the change in exchange rates passes on to the consumer prices in TRNC? What is the degree of pass through?

- How long does the change in exchange rates take to pass on to the prices in TRNC?

In this thesis, we will use consumer price index (CPI) data and exchange rates of Turkish lira that is domestic currency of TRNC against Euro which is the one of the mostly used important currencies for imports and exports of TRNC. We will analyse changes of data monthly starting from 2000 January to 2019 September. In addition to this, there is a control variable data to strengthen the model. This variable is electricity price. In this thesis we will also investigate the effect of electricity price changes on TRNC's consumer price index as it has actually been one of the biggest problems of the TRNC for a long time. So, our additional research questions are:

- How much of the change in electricity prices passes on to the consumer prices in TRNC? What is the degree of pass through?

- How long does the change in electricity prices take to pass on to the prices in TRNC?

Republic of Turkey's economy that uses TL like TRNC has significant impact on TRNC's economy. So, we can guess that the effects of exchange rate changes in Republic of Turkey should be in the same direction or similar with TRNC. However, we cannot forecast anything about how many of the change in Republic of Turkey's economy reflect on the TRNC. So, this is another motivation for us to do this study. According to Leigh & Rossi (2002), effects of pass through on Turkey is mostly felt in the first 4 months and over after a year. In addition to this, it shows us the strong correlation between exchange rate and the consumer price index. This shows that

market takes actions in short period and exchange rate has important impacts on consumer prices. With these results we can say that this study will be using consumer price index data for measuring exchange rate effects.

1.3 Limitations of the Study

The main limitation of the study is data sources. Many studies, as stated in the literature review, have used imported goods price index. This enables the research to see the direct impact of the changes in the exchange rates on the prices of imported goods which are specifically priced in foreign currency. In addition, there are no wholesale price indices which are another important price change indicator in the markets.

As for the structure of the thesis, after the introduction which has outlined the study, chapter two reviews the relevant literature of the subject. In chapter 3 data and methodology adapted is explained. Chapter four outlines the empirical results and chapter five concludes the study.

Chapter 2

LITERATURE REVIEW

There are lots of studies on the exchange rate pass through subject. These studies aim to determine the effects of exchange rate changes on prices. In the recent decades, the exchange rate pass through has become more important for developing countries, particularly those are using floating exchange rate regime. Because the exchange rate fluctuations, which are generally high in these countries, reflect considerably on the general prices level. So, it is important for these countries to know that when and how much ERPT affects price level so to take actions against inflation. In addition to these, ERPT results generally differ from country to country and this makes it more interesting to see results of different countries. In this chapter, first definition of ERPT will be done in detail. Then, review of the literature will be outlined.

2.1 Definition of ERPT

Definition of ERPT is generally based on price fluctuations created by exchange rate changes in most of studies. In other study Bache (2007), explains the ERPT as it is the elasticity of prices with respect to the exchange rate, keeping other determinants of prices fixed.

We can better understand the ERPT concept with a simple example. Let's say "X" is a company that produces computers in Turkey and pays all costs with domestic currency, Turkish lira (TL). United Kingdom imports computers of the X firm from Turkey. The computer's price in United Kingdom market should be the amount that

multiplies Turkish Lira value of computer with spot exchange rate between pound and lira. We can formulate it like;

$$P^{£}_{C} = P^{₺}_{C} * FX \tag{1}$$

$P^{£}_{C}$ is the price of the computer in United Kingdom Pound, $P^{₺}_{C}$ is the price of a computer in Turkish lira, and FX is the number of liras per pound. If the price of a computer in Turkey is ₺1000 and exchange rate between £ and ₺ is 1, the price of the same computer in United Kingdom is £1000. Let's say the lira appreciated 20% against the U.K. pound. The price of computers that are produced in Turkey and sold in U.K. markets will change due to this appreciation. If the price of a computer in pounds increases same percentage as E multiplier and becomes £1200, this means complete pass-through. This is because all FX changes passed on to the computer price. But if the price of a computer in United Kingdom increases less than appreciation rate and it becomes less than £1200, we say pass through is partial.

There is lots of studies about exchange rate past through in literature. Measuring all effects of exchange rate changes is not simple like adding two numbers and finding an exact result. So, there is some several ways to measure exchange rate pass through. For ERPT measurement, there is various variable and time period usage. Different studies can use different variables even if they used same country's data. Because ERPT results can be improved with their additional findings. Also, different time periods change the ERPT results. However, ERPT results of the studies that are made for same country, expected to be close to each other. There is a table below that summaries the literature reviewed on ERPT. We used more studies that is made for Turkey. Because of the strong links of the economy with TRNC economy. We will explain each study in next.

Table 2.1: Literature Review

Authors & Published Year	Time interval and Frequency	Country(ies)	Variables	Method
Leigh & Rossi (2002)	1994:01-2002:04 Monthly	Turkey	Nominal exchange rate, oil prices, real output, wholesale prices, consumer prices	Recursive VAR
Campa & Goldberg (2005)	1975-2003 Quarterly	23 OECD Countries	Import prices, exchange rate, exporter cots, real GDP	Log linear regression
McCarty(2007)	1976:01-1998:4 Quarterly	9 of OECD Countries	Oil prices, output gap, exchange rate, import prices, interest rate, money growth, CPI and PPI	VAR
Kara, H. & Öğünç, F. (2008)	1994:01-2004:12 Monthly	Turkey	Output gap, imported inflation(import prices and exchange rates), and core CPI	VAR
Jiadan Jiang & David Kim (2013)	1999:01-2009:09 monthly	China	Money stock, interest rate, exchange rate	Structural VAR
Arslaner, et all. (2014)	1986:01-2013:07 monthly	Turkey	CPI, PPI, exchange rate	VAR, Markov switching regression
Suna Korkmaz & Musa Bayır (2015)	2003:01-2014:11 Monthly	Turkey	Nominal effective exchange rate, producer price index and consumer price index	Granger Causality
Alptekin,V., Yılmaz, K.Ç. & Taş, T. (2016)	2005:01-2015:04	Turkey	Production gap, exchange rate, import unit value index, producer price index	VAR

2.2 ERPT Literature on Country Specific

Leigh & Rossi (2002), studied about ERPT in Turkey. They used monthly data from January of 1994 to April of 2002. In their study they employed recursive VAR method and used nominal exchange rate (USD), oil prices, real output, wholesale prices, consumer prices variables for estimation. According to this study, effects of pass through in Turkey mostly felt in the first 4 months and over after a year. In addition to this, it shows us the strong correlation between exchange rate change and the consumer price index. This indicates that market takes actions in short period and exchange rate has important impacts on consumer prices. At the first 4 months ERPT is found to be 0.5 and 0.4 for WPI and CPI, respectively. In addition to this, for the 11 months ERPT is 0.6 and 0.45 for WPI and CPI, respectively. So, the estimated ERPT is found to be passing on to the prices fast and at high degree in Turkey which is a developing country.

In another study Hakan Kara & Fethi Öğünç (2008) used VAR method to find the effects of imported inflation on domestic price changes. To find ERPT, they used data between January 1994 and April 2001, and between May 2001 and December 2004. In addition to this they used data for inflation targeting and realization from June 2002 to February 2007. The variables are output gap, imported inflation (import prices and exchange rates), and core CPI. In their study they find ERPT at pre inflation targeting regime to be high and rapid and at post inflation targeting becoming weakened. The weakening is more effective on CPI than wholesale prices. In addition to this they also showed that correct application of inflation targeting is important tool to reduce ERPT. There is 80% ERPT taking place in 4-5 months and

in 10-11 months for core CPI before and after inflation targeting regime, respectively.

Jiadan Jiang & David Kim (2013) used the structural VAR (SVAR) method to find reflection of exchange rate fluctuations on prices with domestic monetary policy effect for China. They used monthly data from first month of 1999 to ninth month of 2009. The other variables are money stock, interest rate, exchange rates. The findings state that (1) for both PPI and RPI, the ERPT is not fully completed; (2) the ERPT is more influential on producer price index; (3) the exchange rate pass through to retail price index and the producer price index are approximately at the same speed. The findings of structural vector autoregression show that having a stationary exchange rate is significant for China's inflation. The short run ERPT results are 0.27 and 0.11 for WPI and CPI, respectively. In addition to this, the long run results are 1.02 and 0.62 for WPI and CPI, respectively.

The study of Arslaner, F., Karaman, D., Arslaner, N., & Kal, S. H. (2014), aimed at finding the effects of exchange rate pass-through on Turkey's inflation targeting. They used Turkey's monthly data between first month of 1986 and seventh month of 2013. The variables are CPI, PPI, Nominal effective exchange rate. The methods that used to analyse these data are VAR, Markov switching regression, single regressions, correlation coefficients. In their results, ERPT was found to be high and rapid. In addition to this, it was concluded that the impact on producer price index was higher than Consumer Price Index. ERPT degree to consumer price index and producer price index founded to be 48% and 52% respectively. Lastly, monetary crises and changes in the level of openness of the country had a significant effect on pass through.

In another study, Suna Korkmaz & Musa Bayır (2015) used Granger Causality to find effects of exchange rate fluctuations on domestic prices in Turkey. They used monthly data from January 2003 to November 2014. The variables used in the study are nominal effective exchange rate, producer price index and consumer price index. They found one-way causality from exchange rate to producer price index (PPI) and CPI to exchange rate.

The study of Alptekin, V., Yılmaz, K.Ç. & Taş, T. (2016) deals with the reflection of exchange rate pass-through on producer price index and consumer price index for Turkey with using VAR method. The analysis made separately for both of PPI and CPI with data that is between January 2005 and April 2015. The variables used in the study are production gap, exchange rate, import unit value index, producer price index and consumer price index. The findings state that after 2001 pass-through from exchange rate to prices are in downward trend, and the exchange rate pass through on consumer price index is less than producer price index. They state that the reason of low ERPT is due to the effect that firms absorb significant amount of the change in foreign exchange and do not choose to reflect them on the prices, is the profit margin changes made by seller firms not to lose their markets. This is done to minimize the risk of losing customers and market share.

2.3 ERPT Literature Studied on Cross Countries

Campa & Goldberg (2005), studied about exchange rate pass through effect onto import prices. In this study they gathered 23 selected OECD countries' quarterly data that is from January 1975 to April 2003. The variables used in the model are import prices, exchange rate, exporter cots, real GDP. They defined exchange rate, import price mark ups and marginal cost of producer with usage of lagged exporter inputs'

cost, importer demand quantities and exchange rates. Additionally, for the exchange rate pass through, they emphasized effects of competition. The results are found to be differing among for the 23 OECD countries. This implies that ERPT has different implication in different economies. They estimated ERPT elasticity of these countries. Their cross-country demonstration assists partial ERPT in short run with only a quarter. They found unweighted average of pass through elasticities of all countries is around 46% for 3 months and 65% for long therm. The study finds that import price responsiveness has relatively low elasticity in the short run. However, pass through elasticity are close to 1 in long run.

McCarty (2007) studied about effects of changes in rate of exchange and import prices on PPI and CPI with using VAR method. The data are from USA, Japan, Germany, France, UK, Belgium, Netherlands, Sweden, Switzerland countries. The observation interval starts at January of 1976 and finishes in April of 1984. The variables of this study are oil prices, output gap, exchange rate, import prices, interest rate, money growth and producer and consumer price indices. The results of the study show that ERPT effects on general consumer price changes are not so big in developed countries. In addition to this, changes in import prices are more effective than changes in exchange rate on consumer prices in developed countries.

2.4 Main Findings from the Literature

There are lots of factors that have effect on consumer price indices. ERPT degree of each country is different. Studies have shown that ERPT is higher in the developing countries relative to developed countries. In the paper of Taylor (2000), we can see that the responsiveness of prices to exchange rate changes depends positively on inflation. Studies generally shows that the degree of ERPT in order from bigger to

smaller is import prices, after producer prices, and for consumer prices. This situation can explain with the price adjustment from exporters and seller for not losing customer in competitive world. Developing market countries' ERPT to domestic prices is generally found to be higher and faster than in developed countries.

Chapter 3

DATA AND METHODOLOGY

The reviewed literature in the last chapter shows that most of the ERPT studies used Vector Autoregression (VAR) as method (see Table 2.1 for summary). We also used standard VAR model in this study. One of the reasons of it is our literature review findings, which make us to think that VAR is the most appropriate method for the analysis. For having better support for VAR method usage, we will give brief information about the method. Stock & Watson (2001), stated in their study that;

> "A VAR is an n-equation, n-variable linear model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining n-1 variables. This simple framework provides a systematic way to capture rich dynamics in multiple time series, and the statistical toolkit that came with VARs was easy to use and to interpret."

One of the main objectives of this study is to determine how much of the exchange rate change reflects on CPI. In addition, the study aims to find out how many months the impact of an exchange rate fluctuation continues. These objectives are good reasons to use VAR method. Because the VAR method does not use direct VAR values, it uses Granger causality test and impulse responses for interpretation of results. Causality results investigate that if lagged values of one variable work to forecast another variable. Impulse response results simply show us the reaction of present and future values of dependent variables to one unit increase in present value of the errors of an independent variable. In addition, we used electricity prices as control variable to strengthen the model.

In this study the time series data is the most appropriate because we want to see monthly effects of changes in exchange rate for TRNC economy. Data set includes inflation, foreign exchange rate, with monthly frequency and electricity prices from January 2000 to September 2019. Monthly changes in consumer price index (CPI) represents inflation variable and monthly change in the sale price of Euro to Turkish Lira represents foreign exchange variable. Furthermore, per kilowatt-hour (kW/h) price is used for electricity variable in the analysis. This study used only CPI for price level changes as there are no available wholesale or import pricing data of TRNC for a long period. In addition to this, we used Euro for the exchange rate variable as Euro is the one of the most used currency for trade in TRNC. The Var estimations also shows that more than one currency cannot be used due to multicollinearity problem.

As we see from Figure 3.1 below, Euro and CPI changes move together but the change in exchange rate is relatively higher than in CPI. The results show much better association between the CPI and change in the exchange rates. The line graph clearly shows that the CPI neither has been stable and not low. The fluctuations especially in the beginning of the study period, from 2000 to 2003, were at very high levels. These are the years when there was an exchange rate regime change in Turkey from fixed to floating exchange rate regime (CBRT, 2020).
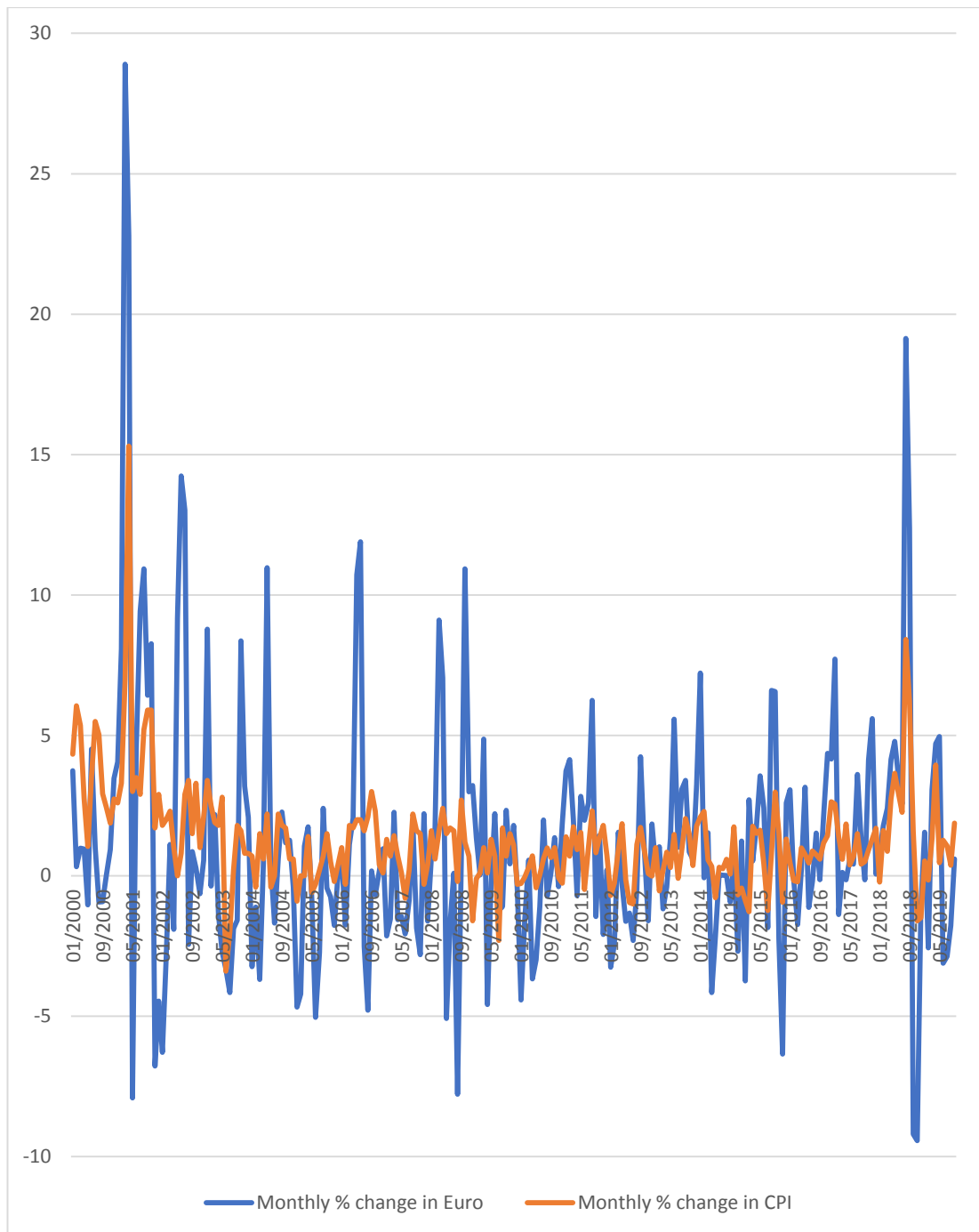
Figure 3.1: Monthly changes in CPI and Euro

The Figure 3.2, represents yearly change in both exchange rates and the consumer

price index. This figure gives a clearer picture about the change in the two main

indicator of the study.
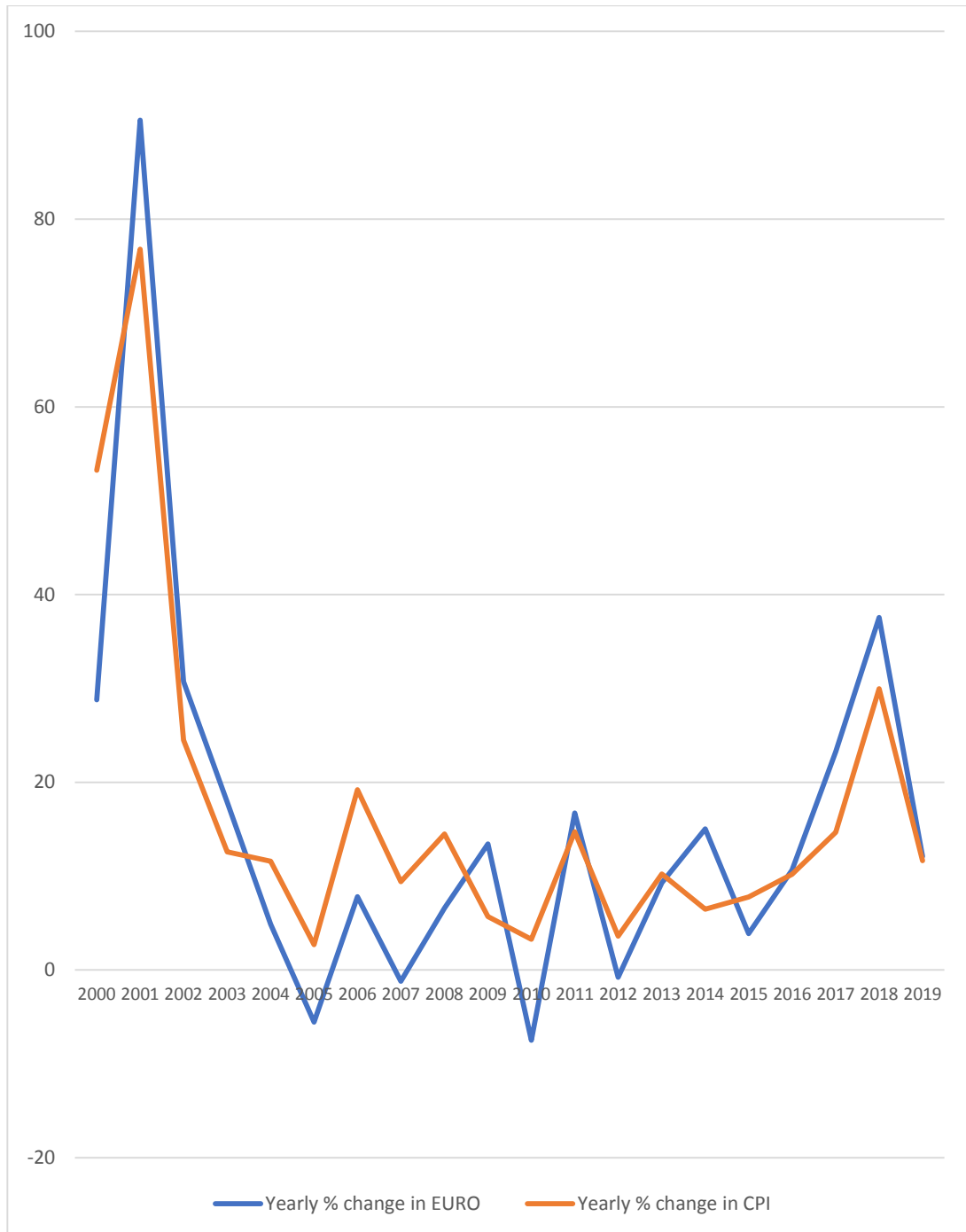
Figure 3.2: Yearly changes in CPI and Euro

This fundamental change in the exchange regime coupled with the banking crisis in those years led to significant decrease in the value of TL against other major currencies. Being in the same currency zone, Lira-Zone, TRNC also got negatively affected and also faced high inflation rates in those years. This contagious effect on TRNC has calmed down with the stability of Turkish economy after 2003. Between

2004 and 2018 August, the change in the exchange rates and the CPI have fluctuated between 5 to maximum 20 percent, which is still not very low for a such a small, micro economy of TRNC. In 2018 August, collapse of the TL again has had spill over effects on the CPI in TRNC and has pushed the inflation as high as 29,9 percent in 2018 (SPO, 2019). The graphical presentation clearly shows that there is a high degree of correlation and relation between the change in the exchange rate in Euro and the inflation in TRNC.

The CPI and electricity price data are collected from State Planning Organization (SPO) of TRNC. The exchange rate data, which are based on sale price of Euro against Turkish Lira, are collected from Central Bank of the Republic of Turkey.

3.1 Development of the Hypothesis

The aim of this study is to find exchange rate pass through effect on TRNC's CPI. The effect of the change in exchange rates on the prices is very much felt by the citizens in TRNC. This is very much experienced in our real life. The hypothesis will be tested to see if there is strong relationship between exchange rate and consumer prices in TRNC. In addition to these, the study will use per KW/H electricity price as control variable to price changes. The hypotheses will be as follow:

H_1: Changes in the exchange rate have significant effect on inflation in
    TRNC.

H_2: Changes in the electricity prices have significant effect on inflation in
    TRNC.

3.2 Descriptive Statistics

As Table 3.1 represents, we have 237 observations for each variable that are used in this study, which the number of observations is enough amount to have meaningful results in the analysis. Mean value of changes in TRNC CPI, which is 1.28 %, is greater than electricity price and Euro changes' mean values, which are 0.38% and 1.15%, respectively. In addition, maximum and minimum values of CPI of TRNC significantly differ from Euro exchange rate. This situation also expected because we know that there is no complete ERPT in any country. So, changes in CPI will be less than changes in Euro.

Table 3.1: Descriptive Statistics (monthly change)

	CPI	EURO	ELECTRICITY PRICE
Mean	1.28	1.15	0.38
Maximum	15.30	28.90	0.99
Minimum	-3.40	-9.43	0.04
Number of Observations	237	237	237

3.3 Correlation Coefficients

As we be seen in the Figure 3.3, the correlation between Euro and CPI are highly and positively correlated. The results of the Pearson correlation finds that both change in Euro and electricity are statistically significant at 1% level. These results state that changes in Euro and CPI are positively correlated as much as 0.57. The change in electricity variable is also correlated with CPI by 0.20. The Pearson correlation matrix also show that there is no multicollinearity problem since all coefficients are below 0.8.

Table 3.2: Pearson Correlation Matrix

	EURO	CPI	ELECTRICITY
EURO	1		
CPI	0.573***	1	
ELCT	0.051	0.202***	1

*, **, *** shows significance level at 10%, 5%, and 1%, respectively

3.4 Unit Root Tests

In time series analysis, it is important that the data series which are used are stable. In order to confirm this, we applied unit root tests to define and solve if there is unit root problem. All test that we made for unit root show us similar results. So, we will explain our results with the Augmented Dickey-Fuller test. The Augmented Dickey-Fuller test shows us if our data set is stable or not with unit root test. The probabilities that are at minimum 95% significance level, whose probability values

under 0.05, implies that the data is stationary. For the data that we have for our study using Augmented Dickey Fuller test we find that there is no unit root for CPI and Euro. However, the electricity data set shows that there is unit root problem. As you can see in Table 3.3 in order to solve unit root problem we took first difference I(1) of electricity data series. By taking the first difference the data series became stationary and the unit root problem was eliminated.

Table 3.3: Augmented Dickey Fuller Unit Root Test

Variables	T-values	Probability	Test Result
CPI	-8.470	0.000	There is no unit root
Euro	-10.637	0.000	There is no unit root
El	0.323	0.979	There is unit root
D(El)	-12.881	0.000	There is no unit root

Table 3.4: Phillips-Perron Unit Root Test

Variables	T-values	Probability	Test Result
CPI	-8.655	0.000	There is no unit root
Euro	-10.234	0.000	There is no unit root
El	-2.035	0.579	There is unit root
D(El)	-12.97748	0.0000	There is no unit root

In this chapter we have introduced our model and described the data. We have carried out preliminary tests including correlation to see if there exist any correlation between the variables. We have also applied unit root test to confirm the stationarity of the data series. In the following chapter we will be using the data described in this chapter and try to estimate the ERPT.

Chapter 4

EMPIRICAL RESULTS

In this chapter, the data and the methods, which were explained in the previous chapter, are going to be used to determine and estimate ERPT to prices in TRNC.

As a first step, in order to determine the optimal lag for VAR estimation, we used Akaike information criterion (AIC), Hannan–Quinn information criterion (HQ), and (SC) Schwarz information criterion. According to study of Gutiérrez et. al (2007), AIC is the best for this study since number of observations is around 200 and AIC give the most robust lag for the model. We check the VAR lag order criteria to determine the optimal lag. As it is stated in Table 4.1, the "*" in the AIC column show that using 5 lags are the best for our VAR estimation.

Table 4.1: Lag Length Criteria

Lag	AIC	SC	HQ
0	4.520711	4.565834	4.538916
1	4.055056	4.235548*	4.127879*
2	4.046950	4.362811	4.17439
3	4.065883	4.517113	4.247941
4	4.055469	4.642068	4.292144
5	4.041975*	4.763942	4.333267
6	4.005500	4.937392	4.425965
7	4.124657	5.117362	4.525184
8	4.136325	5.264399	4.591469

After determining the optimal lag length, we used the Granger casualty to verify the VAR analysis. In other words, if the Granger causality does not support the VAR, the analysis will be meaningless. This is because the Granger causality test is a hypothesis test for finding out whether a variable is useful in predicting another variable or not (Granger, C. W., 1969). In addition, the Granger causality shows the relation and the direction of the relation.

The probability values at Table 4.2 shows that the change in the Euro and the change in electricity prices granger cause the CPI in TRNC. As the Table 4.2 states the changes in Euro Granger causes CPI at 1% significance level. We also find that change in electricity prices Granger causes CPI and it is significant at 1% level. Overall, model shows that all variables granger causes CPI and they are statistically significant. In total the granger causality test verifies the VAR analysis.

Table 4.2: Granger Causality

Dependent variable: CPI			
Excluded	Chi-sq.	df	Probability
EURO1	50.262	5	0.000
EL1	17.985	5	0.003
All	60.492	10	0.000

After the verification of the VAR analysis with the Granger causality test, we move to VAR analysis. The Table 4.3 shows us the VAR analysis results. The interpretations of VAR model parameters are not very meaningful so we will use impulse responses to find ERPT ratios in next parts. The R-squared and adjusted R-squared values of VAR estimation are 0.4612 and 0.4236 respectively for Euro

which is one of the independent variables. It is good to have close values of them because it means that values are not just some random numbers. R-squared value states that 46.12% of change in CPI can be explained by this model and adjusted R-squared value indicates that 42.36% of change in CPI can be explained by this model. The F statistic shows that our model is 99% significant. The Table 4.3 also shows significance level of coefficients at 10%, 5%, and 1% with *, **, and ***, respectively. As found above, we also confirm here that at the 5th lag, variables turn to be significant.

Table 4.3: VAR Results

	CPI	EUR	EL1
CPI(-1)	0.16765**	-0.45929*	0.00115
	-0.08045	-0.24796	-0.00127
	[2.08380]	[-1.85229]	[0.90484]
CPI(-2)	0.09219	0.12848	0.00046
	-0.08120	-0.25026	-0.00128
	[1.13536]	[0.51338]	[0.35823]
CPI(-3)	-0.11515	0.13205	0.00075
	-0.08059	-0.24837	-0.00127
	[-1.42884]	[0.53166]	[0.59299]
CPI(-4)	0.10526	0.04584	-0.00259**
	-0.08006	-0.24674	-0.00126
	[1.31476]	[0.18579]	[-2.05497]
CPI(-5)	0.28307***	0.50010**	0.00002
	-0.07284	-0.22449	-0.00115
	[3.88629]	[2.22776]	[0.02017]
EUR(-1)	0.16391***	0.54448***	0.00027
	-0.02619	-0.08073	-0.00041
	[6.25778]	[6.74459]	[0.64707]
EUR(-2)	-0.06760**	-0.24566***	-0.00076*
	-0.02867	-0.08837	-0.00045
	[-2.35769]	[-2.77994]	[-1.69171]
EUR(-3)	0.10021***	0.08468	0.00061
	-0.02929	-0.09026	-0.00046
	[3.42156]	[0.93819]	[1.32037]
EUR(-4)	0.00045	0.00904	0.00038
	-0.02929	-0.09028	-0.00046
	[0.01538]	[0.10013]	[0.82095]

EUR(-5)	-0.03913	-0.19093**	0.00039
	-0.02678	-0.08253	-0.00042
	[-1.46117]	[-2.31338]	[0.93556]
EL1(-1)	15.36026***	45.39872***	0.13825**
	-4.39573	-13.54770	-0.06919
	[3.49436]	[3.35103]	[1.99828]
EL1(-2)	-4.28700	-7.29086	0.07804
	-4.46479	-13.76050	-0.07027
	[-0.96018]	[-0.52984]	[1.11054]
EL1(-3)	1.07279	-13.93163	0.00922
	-4.45848	-13.74110	-0.07017
	[0.24062]	[-1.01387]	[0.13144]
EL1(-4)	-7.02540	1.32168	-0.03042
	-4.40857	-13.58730	-0.06939
	[-1.59358]	[0.09727]	[-0.43836]
EL1(-5)	-5.78421	-20.94891	-0.01381
	-4.42406	-13.63500	-0.06963
	[-1.30744]	[-1.53641]	[-0.19835]
C	0.36519***	0.43813	0.00241
	-0.12934	-0.39863	-0.00204
	[2.82345]	[1.09910]	[1.18377]
R-squared	0.46120	0.25489	0.10105
Adj. R-squared	0.42361	0.20290	0.03834
F-statistic	12.26919	4.90307	1.61123
Number of coefficients	48		

*, **, *** shows significance level at 10%, 5%, and 1%, respectively

The Autocorrelation problem is one of the important statistical problems. The Table 4.4 shows us the VAR residual serial correlation Lagrange Multiplier (LM) test. The table explain us whether there is autocorrelation problem. The null hypothesis of this test is there is no autocorrelation problem and alternative hypothesis is we are failing to say there is no autocorrelation problem. So, we want higher values for saying it fails to reject the null hypothesis. All of the probability values in the table are greater than 0.1, which means even in 90% significance level values are not meaningful. So, our test results fail to reject null hypothesis and there is no Autocorrelation problem in this model.

Table 4.4: Autocorrelation test

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	12.92353	9	0.1661	1.444238	(9511.2)	0.1661
2	10.50084	9	0.3115	1.170728	(9511.2)	0.3115
3	13.02015	9	0.1617	1.455173	(9511.2)	0.1617
4	13.4214	9	0.1444	1.500606	(9511.2)	0.1445
5	12.95834	9	0.1645	1.448177	(9511.2)	0.1645
6	7.565673	9	0.5784	0.84108	(9511.2)	0.5785

The Figure 4.1 shows us the graph of invert roots of AR characteristics polynomial. It shows that the co-integrating vector is stable during all the observation periods. As we see in the figure, all points are in the unit circle that means when we check real values of this points we will see all of them are under 1. This result shows us the VAR model is stable.
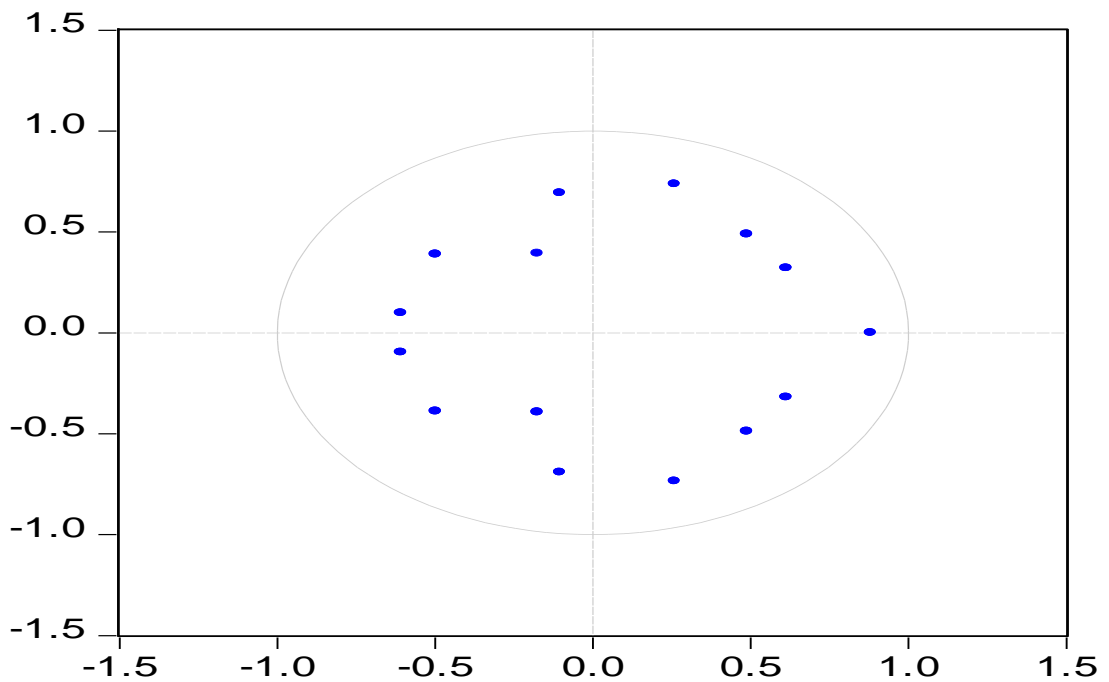
Figure 4.1: Inverse roots of AR Characteristics Polynomial

Impulse-response functions are functions that are found in VAR analysis and show the effects of a standard deviation or one-unit shock in one of the random error terms on the present and future values of the internal variables. In addition, there are ± 1 standard error bands that provide confidence interval around 66 percent for each of the impulse responses. The bands are indicating the patterns of persistent common variation. The standard error terms are representing with red dots in our impulse response graphs. In our impulse response analysis, the responses of the CPI to a shock in the Euro can be measured. In addition, the effects of a shock of one of the variables to other variables can be examined.

In figure 4.2 and figure 4.3, the impulse response of CPI to Euro is showing graphically a monthly change of the euro effects on CPI. Figure 4.2 is also showing the error responses.

These values mean that if we give Euro one standard deviation shock, it will affect the CPI by 54% increase of the standard deviation at first month, 17% at second month, 26% at the third month and followed by 18% increase at fourth month with a final effect in the 5th month as 3%. This also shows that the impact of the shock dies out by the end of 5th month. The impulse response does not show the total amount of ERPT but it shows us the impulse response of a one standard deviation shock. Prices increase after the shock at first month and next month they adjust due to market conditions. The effect on CPI at second month after shock month makes us to say there are adjustments on prices after first shock.
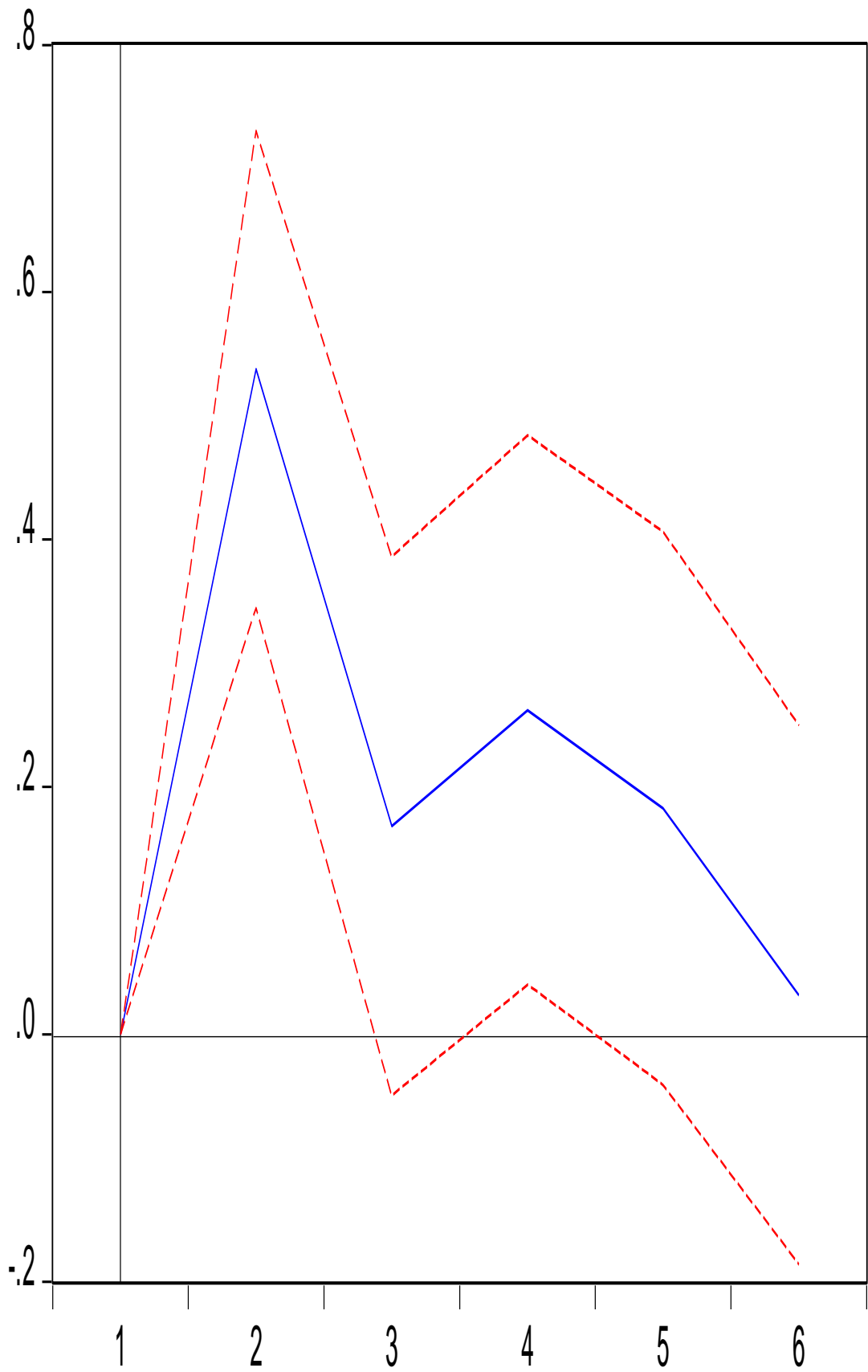
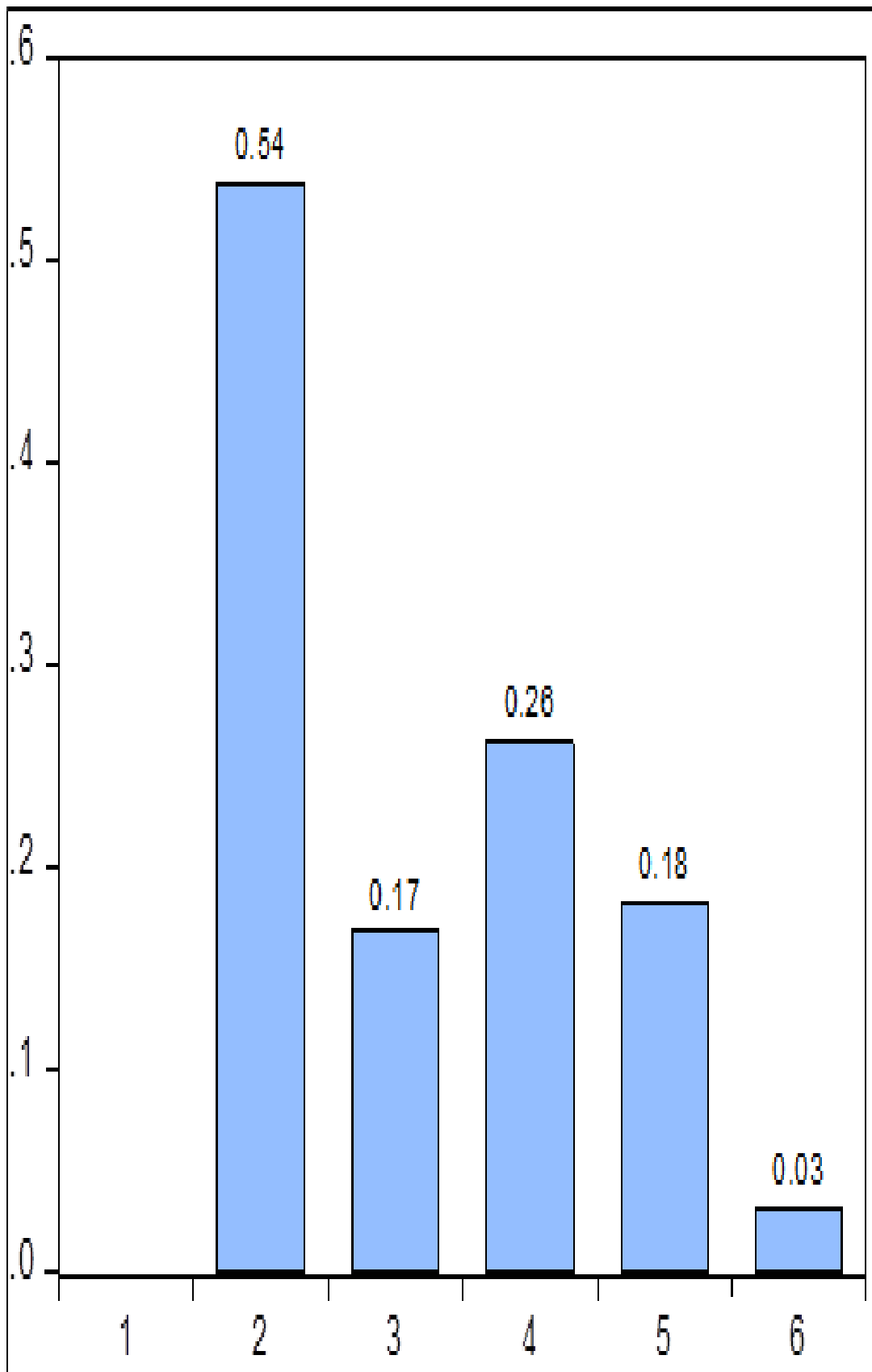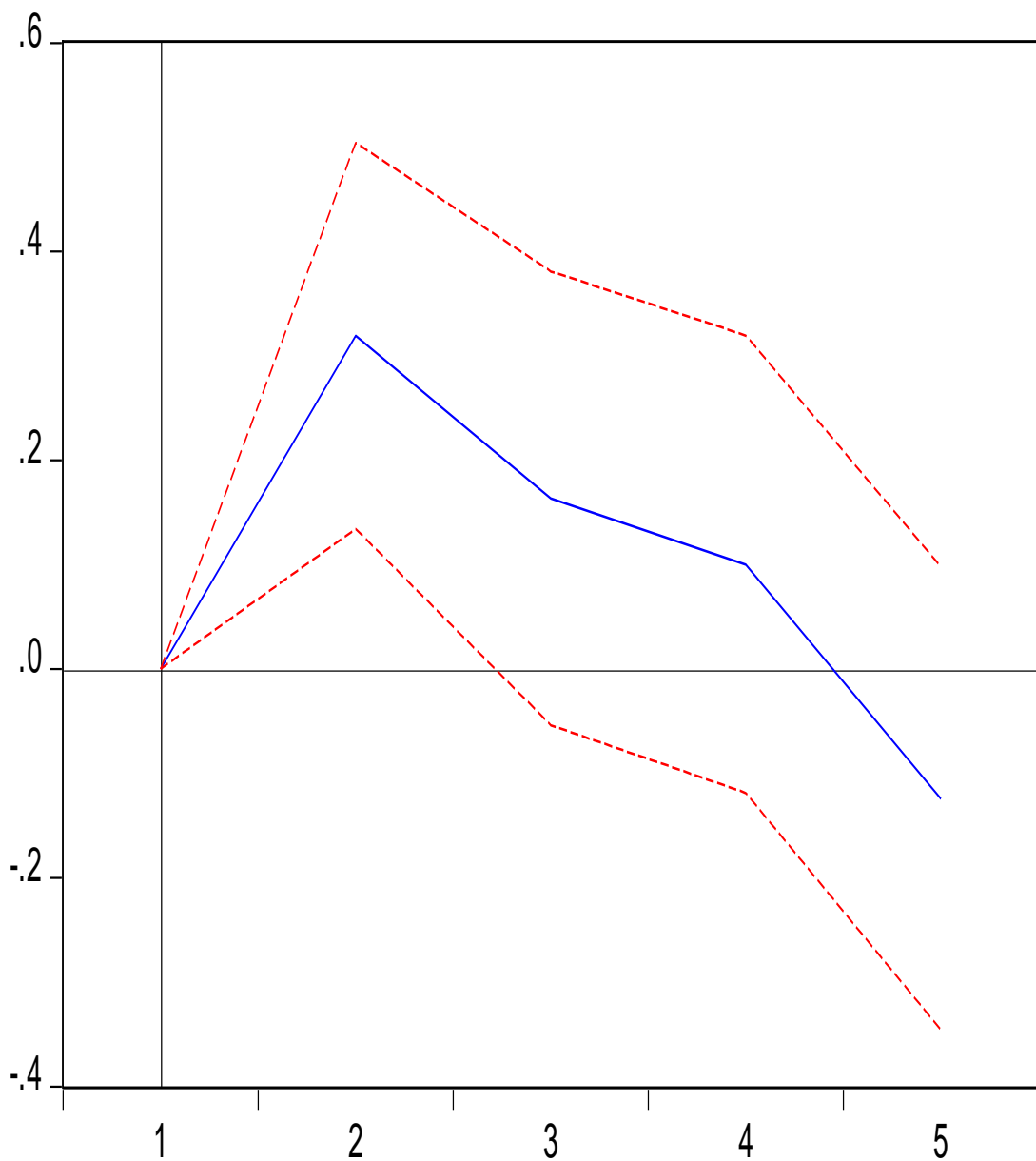Figure 4.2: Line graph of response of CPI to Euro using Cholesky factors

Figure 4.3: Bar graph of response of CPI to Euro using Cholesky factors

The Figure 4.4 and Figure 4.5 presents the impulse response of CPI to electricity prices graphically. These values imply that if we give one standard deviation shock to electricity prices, it will affect the CPI by 31.9% at first month, at second month the effect is 16.3% increase, at third month the effect declines to 10%, and finally it goes to lose its effect after third month. So, the electricity passes through continues for 3 months which is less than the pass through for the exchange rate changes.

Figure 4.4: Line graph of response of CPI to electricity using Cholesky factors
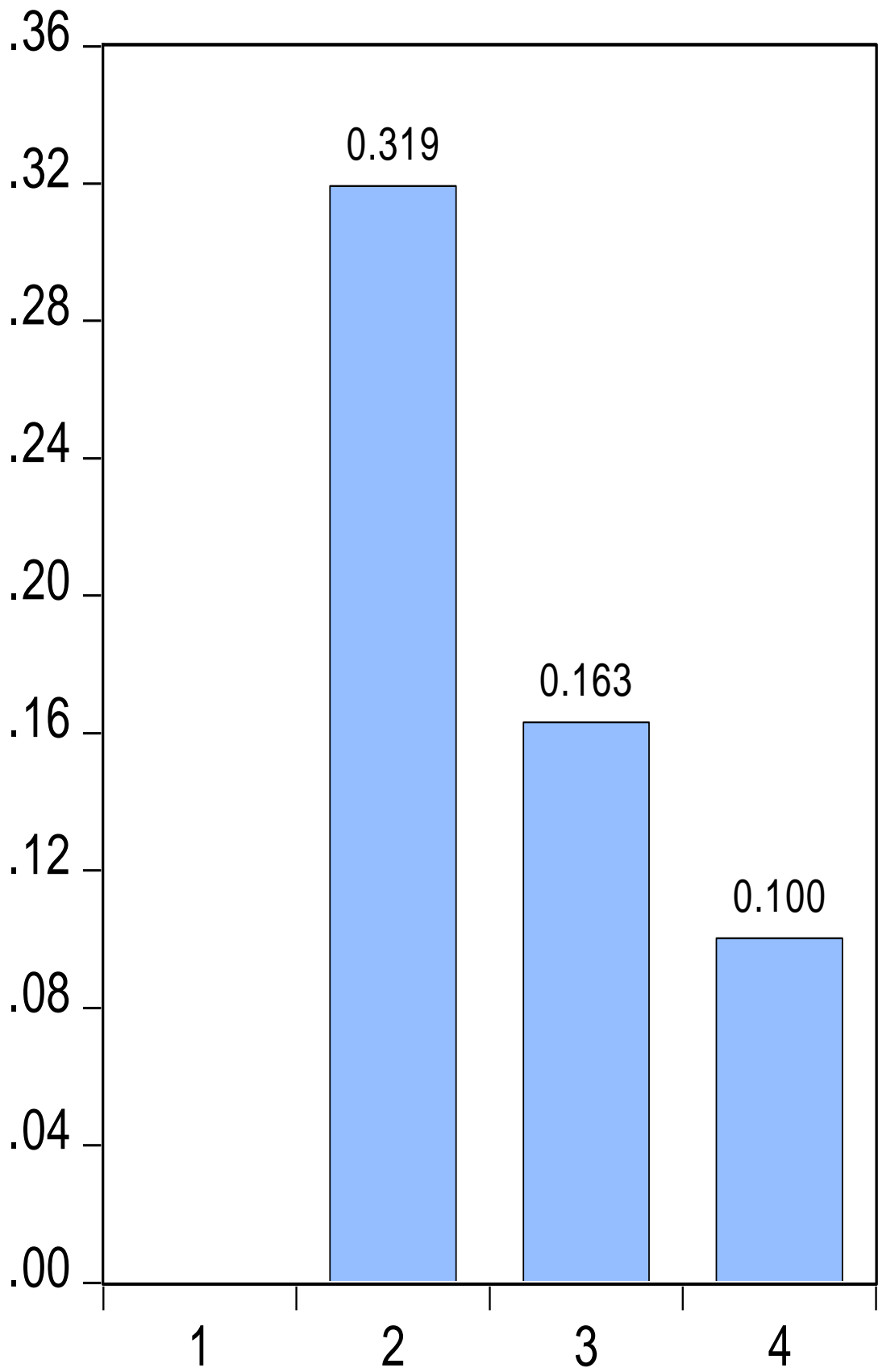
Figure 4.5: Bar graph of response of CPI to electricity using Cholesky factors

The accumulated impulse effect of Euro to CPI can be seen from Figure 4.6 and Figure 4.7. A unit change in Euro variable at first month affect the CPI at second month. The effect starts at second month with 16% and increase to 35% till end of the sixth month (in total 5 months). After sixth month Euro shock's effects disappear. This shows us that the change in Euro has significant impact on the CPI in TRNC and the preliminary findings state that the exchange rate pass through on to the CPI is around 35%. The study of Kara & Öğünç (2008) found that effects of pass through in Turkey is mostly felt in the first 4-5 months and complete after a year. And they found that about 30% of exchange rate shock has passed through to CPI. In addition, they stated that the ERPT to Turkey was higher and rapid than this value before adoption of inflation targeting. Turkey and TRNC are developing countries and in our main findings part we stated that developing countries' ERPT to domestic prices is generally found to be higher and faster than in developed countries. So, the ERPT is rapid and high as TRNC economy as we expect.
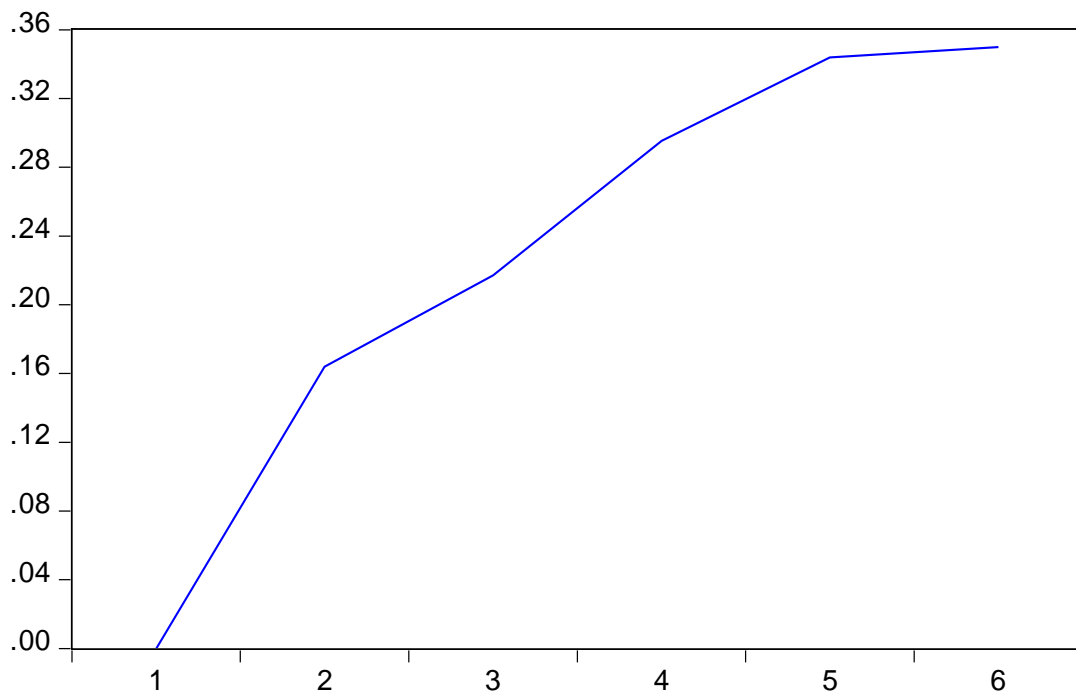

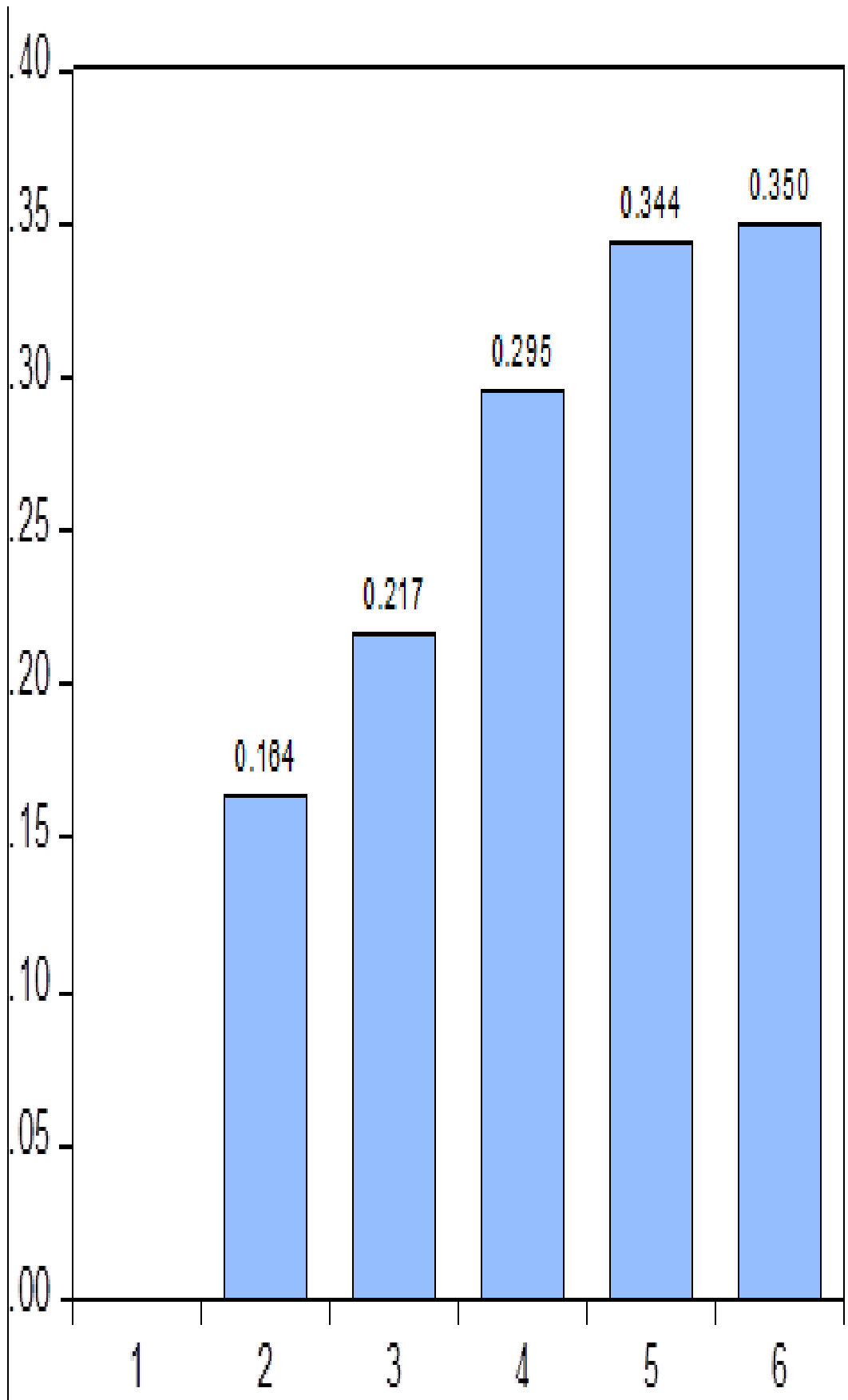Figure 4.6: Line graph of response of CPI to Euro using unit factors

Figure 4.7: Bar graph of response of CPI to Euro using unit factors

The accumulated impulse effect of electricity prices to CPI can be seen from Figure 4.8 and Figure 4.9. A unit change in electricity price variable at first month affect the CPI at second month. The effect starts at second month with 15.4% and increase to 28% till end of the fourth month. After fourth month electricity price shock's effects almost disappear. This shows us that the change in electricity price has significant impact on the CPI in TRNC.
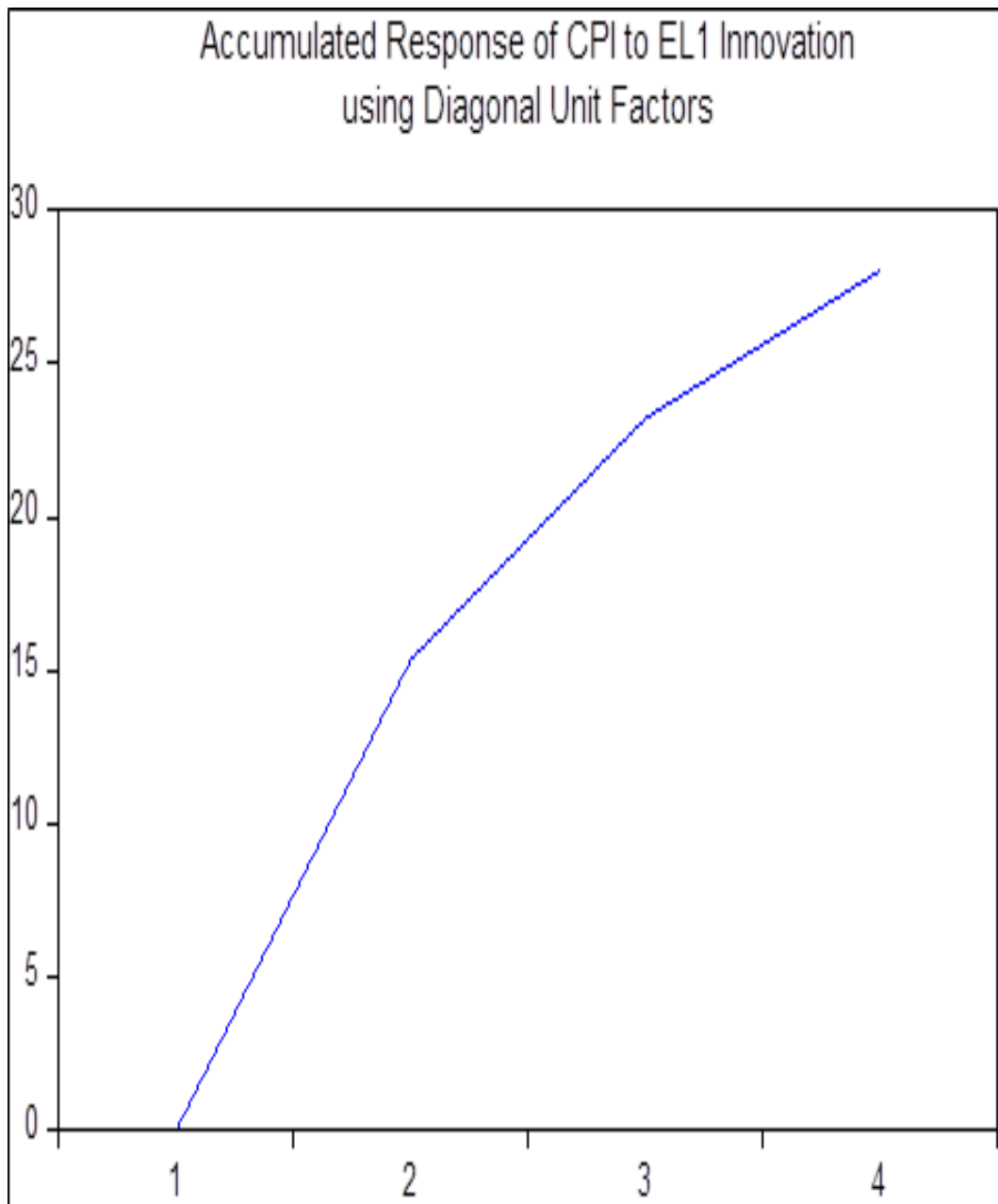

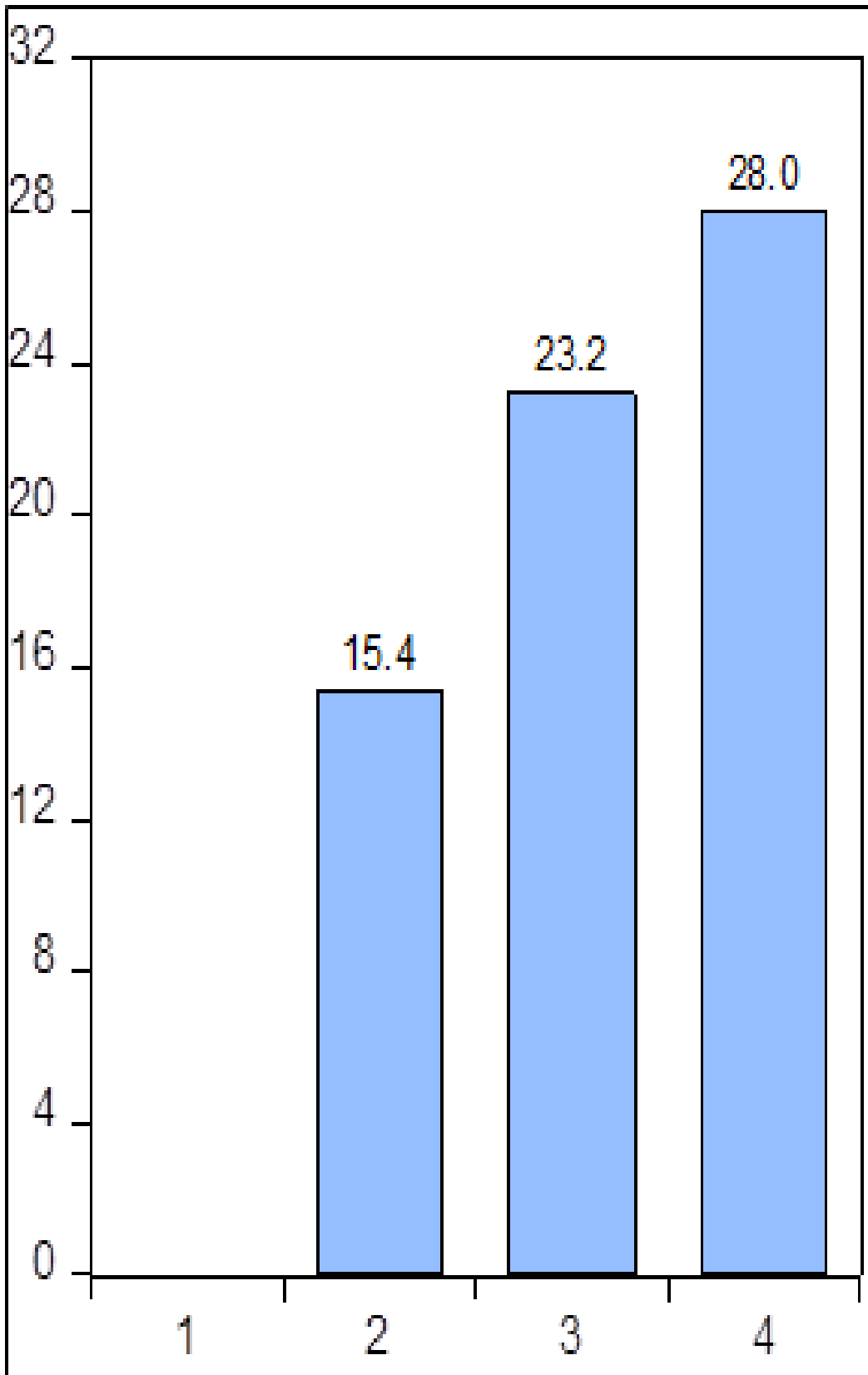Figure 4.8: Line graph of response of CPI to electricity using unit factors

Figure 4.9: Bar graph of response of CPI to electricity using unit factors

Chapter 5

CONCLUSION

This thesis investigates the ERPT in TRNC which is small and import depended economy. TRNC is in Turkish Lira zone with Turkey. So, the change in the value of Turkish Lira has direct impact on the prices in TRNC. Many studies have shown that degree of ERPT for developing countries are higher and faster relative to developed countries. The findings of this thesis are in the same direction. The fluctuations in the value of Turkish lira have significant impacts on the prices. This situation has negative implications on consumers' and businesses' decision behaviours.

In this study, VAR method has been used to estimate the ERPT. Variables that are used in this study are Euro as exchange rate and CPI to represent inflation for TRNC. The data that this study used is monthly and starts from January 2000 and ends up at September 2019 with monthly frequencies. In the result, this study finds that exchange rate pass through is TRNC is high reaching to 35%. The study also found exchange rate pass though takes place in 5 months.

Overall, this study shows that ERPT is high and fast in TRNC and so changes in the exchange rates passes on to prices at very high rates. Policy makers have to develop certain policies to minimize the exposure that the exchange rate changes create through passing on to prices in TRNC.

TRNC economy should start to produce more goods and services to meet its needs with fewer imports and decrease the economy's sensitivity to exchange rate changes. In addition, as is the case for all economies the electricity plays an important role both for production as well as for household budgets. So, TRNC should find ways to lower its cost and effect of exchange rate changes on the cost of production of electricity.

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