EXCHANGE RATE PASS-THROUGH IN TURKEY: ASYMMETRIC COINTEGRATION ANALYSIS

A Master's Thesis

by
AYŞEGÜL DİNÇÇAĞ

Department of
Economics
Bilkent University
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The Institute of Economics and Social Sciences
of
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by

AYŞEGÜL DİNÇÇAĞ

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December 2009

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

Assoc. Prof. Kıvılcım Metin Özcan
Supervisor

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

Assoc. Prof. Dr. Fatma Taşkın
Examining Committee Member

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

Asst. Prof. Dr. Nazmi Demir
Examining Committee Member

Approval of the Institute of Economics and Social Sciences

Prof. Dr. Erdal Erel
Director

ABSTRACT

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DİNÇÇAĞ, Ayşegül

M.A., Department of Economics

Supervisor: Assoc. Prof. Kıvılcım Metin Özcan

December 2009

In this thesis, exchange rate pass-through in Turkey is analyzed using Johansen (1988) and Engle-Granger (1987) two step cointegration procedures. As a result of the analysis, evidence is found for a cointegrating relationship between exchange rates and prices. In addition, asymmetries are tested in the model and it is shown that depreciations lead to a higher degree of pass-through compared to appreciations. In order to analyze the effect of 2001 crisis, structural break tests are applied to the model. It is found that the degree of exchange rate pass-through has decreased significantly since 2001, due to improving conditions and decreasing inflation in the Turkish economy and the reduction in the "indexation" behavior of price setting agents.

Keywords: Exchange Rate Pass-through, Asymmetric Cointegration, Error Correction Model, Johansen Procedure, Engle-Granger Two Step Procedure.

ÖZET

TÜRKİYE'DE DÖVİZ KURLARINDAN FİYATLARA GEÇİŞ ETKİSİ: ASİMETRİK EŞBÜTÜNLEŞME ANALİZİ

DİNÇÇAĞ, Ayşegül

Yüksek Lisans, İktisat Bölümü

Tez Yöneticisi: Doç. Dr. Kıvılcım Metin Özcan

Aralık 2009

Bu tezde Türkiye'de döviz kurlarından enflasyona geçiş etkisi Johansen (1988) ve Engle-Granger (1987) iki basamaklı eşbütünleşme yöntemleri kullanılarak incelenmiştir. İncelemenin sonucunda döviz kurları ve fiyatlar arasında bir eşbütünleşme ilişkisi bulunduğuna dair kanıt elde edilmiştir. Buna ek olarak, modelde asimetrilerin varlığı test edilmiştir ve kurların değer kaybetmesi ile oluşan geçiş etkisinin değer kazanması ile oluşan etkiden daha fazla olduğu gösterilmiştir. 2001 ekonomik krizinin etkilerini incelemek amacıyla modelde yapısal kırılma olup olmadığı da test edilmiştir. 2001 yılı sonrasında Türkiye ekonomisindeki koşulların iyileşmesi, enflasyonun düşmesi ve fiyat belirleyicilerin "endeksleme" davranışından vazgeçmeleri sebebiyle döviz kurlarından enflasyona geçiş etkisinin önemli ölçüde azaldığı bulunmuştur.

Anahtar Kelimeler: Geçiş Etkisi, Asimetrik Eşbütünleşme, Hata Düzeltme Modeli, Johansen Yöntemi, Engle-Granger İki Basamaklı Yöntemi.

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CHAPTER I

INTRODUCTION

Exchange rate pass-through (ERPT) is defined as the effect of exchange rate changes on prices. In a country with an open economy, it is observed that a depreciation of the currency usually leads to an increase in prices, whereas an appreciation of that currency might give rise to a reduction in prices. These exchange rate changes might have one-to-one effect on prices, in which case a "complete pass-through" occurs. Alternatively, a one percent change in the exchange rates might lead to a less than one-percent change in prices. Then, the change in prices is said to be a "partial pass-through".

The literature on ERPT evolved in 1970s, when most countries began to adopt floating exchange rate regimes. Before 1970s, in most of the empirical studies done, it was assumed that any changes to exchange rates would be reflected one-to-one on prices (Kreinin, 1977). However, as many countries switched to floating exchange rate regimes, the availability of more data made it easier to estimate pass-through parameters. It was then observed that not all

economies reflect exchange rate changes completely on prices, even in the long run.

The resilience of prices to exchange rate changes made ERPT an important area of research. In 1980s and 1990s, most of the empirical work on ERPT was done on the U.S. or other developed countries[1]. In the last ten years, there was an increase in the number of studies which analyze ERPT in developing countries, because most of these developing countries adopted floating exchange rate regimes in late 1990s[2]. In addition, most of these countries switched to inflation targeting regimes.

The concept of ERPT is especially important for inflation targeting countries. In order to set the targets for inflation, a central bank has to forecast future changes in exchange rates and estimate what percent of these changes will *pass through* on prices. Furthermore, dynamics of the pass-through must be also examined to predict how long it takes for exchange rates to affect prices. By this way, the responsive actions to exchange rate shocks will be taken in a timely manner and the monetary policy will be effective in fighting inflation.

Since price stability is the primary goal for the monetary policy makers in the inflation targeting countries, the decrease in ERPT under floating exchange rates require that these countries recalibrate their model parameters for inflation targeting. Correct estimation of ERPT parameters in inflation forecasting models is crucial for applying a successful monetary policy. For example, if ERPT is

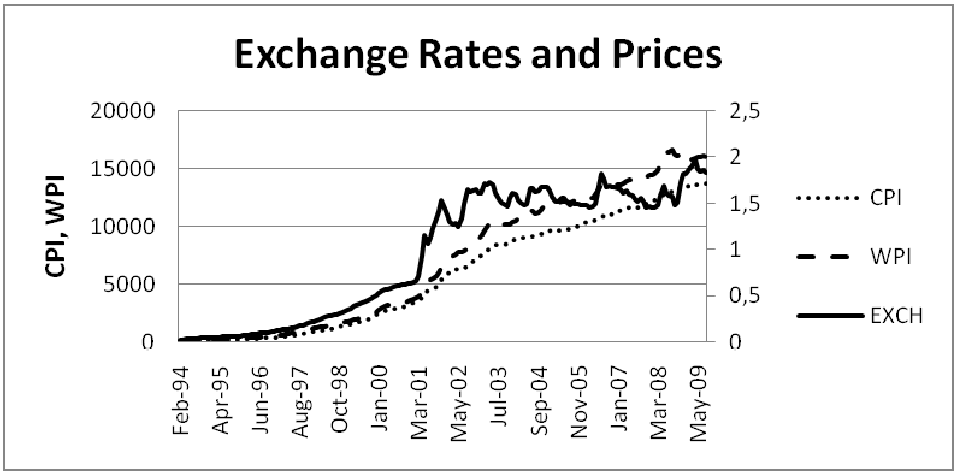
[1] See Menon (1995) for the studies on developed countries.

[2] See Alper (2003) for the studies on developed countries.

observed to be high, central banks have to apply tighter monetary policies when their currencies are expected to depreciate. In contrast, when ERPT is low, there is more room for loosening the monetary policy.

The following observation of exchange rates and prices, illustrated in Figure 1.1., induced us to investigate ERPT for the Turkish case. We believe Turkey is a good candidate to investigate ERPT empirically. A quick glance at the figure below shows that there is a relationship between prices and exchange rates close to one-to-one until 2001. After the enactment of the floating exchange rate regime in 2001, this relationship seems to have weakened significantly, but it does not cease to exist.

Figure 1.1 Exchange Rates and Prices



This observation supports the hypothesis that ERPT is lower under floating exchange rate regimes. The weakening of the relationship between prices and

exchange rates is partly due to the improving conditions in Turkish economy after 2001. However, there might also be other reasons for decreasing ERPT. According to Kara and Öğünç (2005), the decline in pass-through in the recent years partly stems from the fact that exchange rate shocks have not been persistent enough. When we observe exchange rate movements in Figure 1.1, we see that exchange rates continually increase before 2001, but they are highly variable for the floating period. After 2001, when there is a significant depreciation, appreciations follow soon. Kara and Öğünç show that after 2001 the speed of ERPT has decreased, and it takes at least eight months for prices to adjust to changes in exchange rates. When Turkish lira depreciates, there will be an upward effect on prices by ERPT. However, if an appreciation takes place within the following eight months, ERPT will lead to a downward effect on prices. As a result, these upward and downward effects will partially offset each other, and ERPT will be lower compared to pre-2001 period. Although Kara and Öğünç estimate that ERPT has weakened after 2001, they still claim that ERPT could be higher if depreciations of lira were more persistent.

The other possible reason for declining ERPT is that the dynamics of ERPT could be asymmetric. In other words, it could be true that depreciations lead to a higher pass-through than appreciations. When the movements of exchange rates are analyzed, it is seen that the depreciations before 2001 are larger and more persistent, compared to after 2001. If depreciations lead to larger ERPT and appreciations lead to smaller ERPT, the decline in depreciations of lira after 2001 might have led to the decline in ERPT. Therefore, asymmetries in exchange rate movements must also be tested when the dynamics of ERPT are analyzed.

The previous empirical studies on ERPT in Turkey are discussed in the literature survey section. Below is a short summary of these studies. One of the first papers examining the ERPT in Turkey is Leigh and Rossi (2002). Using a VAR model, Leigh and Rossi find out that the ERPT is higher in Turkey compared to other developing countries. Then they explain this finding by high dollarization, indexation, inflationary expectations and the oligopolistic industrial structure of Turkey. Arat (2003), however, criticizes this paper for having incorrect data on oil prices. He replicates the same analysis by modifying the data, and he also finds evidence for complete pass through in the long run. Another paper by Kara and Öğünç (2005) conducts the same analysis with a longer data set, where he separates the data into two subsamples, and finds out that ERPT decreased after 2001.

Other studies with different methodologies from above are Alper (2003), Arbatlı (2003), Kara et al. (2005) and Türkcan (2005). Alper performs a cointegration analysis where he finds evidence for rapid adjustment of prices to exchange rate changes. Arbatli (2003) searches for asymmetries in ERPT using a threshold VAR model. She questions whether the degree of ERPT differs depending on the magnitude of industrial production, inflation and the exchange rate changes. As a result, she finds that economic contractions, high inflation and large exchange rate shocks lead to a lower ERPT. Kara et al., on the other hand, use Seemingly Unrelated Regressions and Kalman filter methodologies to analyze ERPT into domestic prices, where they estimate time varying parameters of ERPT. They find out that the magnitude of ERPT has been diminishing since 2001. Finally, Türkcan uses an elasticities approach to investigate the ERPT on

aggregate and disaggregated import prices. Similar with Arat (2003), he also finds evidence for complete pass through in the long run.

Having been motivated from the above literature and the developments regarding the relationship between exchange rates and prices since 2001, in this thesis we aimed to analyze ERPT for Turkey. The magnitude of pass-through will be estimated as well as its dynamics, using a cointegration and error correction framework. To see the changes in the dynamics of pass-through after the economic crisis of 2001, the analysis will be performed on two subsamples separately: before and after 2001. By this way, the effect of the adoption of floating exchange rate regime on Turkish economy will be elucidated.

In this thesis, our methodology differs from the previous literature summarized above. Evaluating the mechanism of ERPT for Turkey, this study will answer the following question: is there a difference between the magnitude of pass-through during depreciations and appreciations? A quick observation of data hints that there could be an asymmetry in the pass-through process, that is, pass-through might be higher during depreciations. This study, therefore, will seek evidence for asymmetries in the ERPT, for both before and after 2001.

To our knowledge, the asymmetries of ERPT in Turkey have not been analyzed before using a cointegration framework. This study will therefore detect these asymmetries using a “two state regime switching model”. The main question that this study answers is whether there are differences in the degree and dynamics of ERPT during appreciations and depreciations. Other types of asymmetries, that Arbatlı (2003) has already explored, are beyond the scope of this research.

The organization of this thesis is as follows. Chapter II gives information on the theoretical background in the literature on ERPT, discusses the microeconomic and macroeconomic factors behind the cross-country differences in ERPT, and summarizes the ample literature on ERPT. Chapter III gives an overview on the exchange rate regimes and developments in Turkish economy in 1994-2009. Chapter IV explains the data, methodology and empirical results in detail, and Chapter V concludes.

CHAPTER II

LITERATURE SURVEY

2.1 Theoretical Background: Purchasing Power Parity

Exchange rate pass-through literature stems from the literature on Purchasing Power Parity (PPP). PPP basically has two definitions: absolute and relative PPP. Absolute purchasing power parity, also known as “The Law of One Price”, states that all countries have the same level of prices measured in terms of the same currency. This means that the ratio of price levels of any two countries equals the nominal exchange rate, so that the real exchange rate is equal to one. Especially in the short run, this statement is not supported by world data. However, most economists believe that a less restricted form of PPP, relative purchasing power parity, holds in the long run. Relative PPP implies that the real exchange rates are constant, but not necessarily equal to one. As the real exchange rate is given by the formula:

$$Q_{home/foreign} = E_{home/foreign} \times (P_{foreign} / P_{home}) \quad (2.1)$$

where E is the nominal exchange rate and P is the price level, the constant real exchange rate implies that the percentage change in the relative price levels equals the percentage change in the nominal exchange rate. This formula requires that, when foreign prices are constant, any exchange rate change is fully reflected in the price levels at home, which means that there is complete exchange rate pass-through.

In reality, the theory of PPP relies on long run data. In the short run, hypotheses testing both absolute and relative PPP are strongly rejected (Rogoff, 1996). As a consequence of PPP not holding in the short run, complete exchange rate pass-through cannot hold in the short run either. Nonetheless, partial ERPT can occur in the short run.

2.2 Literature Review on Exchange Rate Pass-through

These discussions related to PPP led to the growing of ERPT literature. The next subsection cites the literature on ERPT explaining the cross-country differences by microeconomic and macroeconomic factors. Then, the following subsections summarize the empirical literature on ERPT.

2.2.1 Microeconomic and Macroeconomic Factors Affecting the Degree of ERPT

There are some studies that attribute differences in ERPT among countries to microeconomic factors. For example, Dornbusch (1987) argues that ERPT is lower in countries with high substitutability of goods in the market. Another study on ERPT that emphasizes microeconomic factors is Fischer (1989), where the author claims that ERPT increases with market segmentation. Both market integration and substitutability of goods reduce pricing power of firms. Therefore, exchange rate changes are not reflected into prices completely. As a result, market integration and substitutability reduce ERPT.

Menon (1995) notes that multinational corporations generally follow "pricing to market" strategies, which implies that their price setting behaviors are affected less by exchange rate shocks. Therefore, the existence of multinational corporations in a market will reduce ERPT. Menon, in his survey article, also quotes that some scholars like Bhagwati (1988) and Branson (1989) claim that non-tariff barriers also reduce pass-through. These scholars argue that when the currency depreciates, import premiums are reduced in order to avoid an increase in import prices. Therefore, ERPT is reduced when non-tariff barriers exist.

Another microeconomic factor explaining the differences in ERPT is the structure of imports. According to Maria-Dolores (2008), countries with higher import share of goods like raw materials and energy will exhibit higher ERPT compared to countries with higher import share of manufactured goods.

According to scholars such as Campa and Goldberg (2002), microeconomic factors are more important explaining the ERPT differences between countries. However, recent studies attribute the differences in ERPT between countries to macroeconomic factors. Among these studies, Taylor (2000) hypothesizes that in a country where there is high and persistent inflation, ERPT is usually high. Since high inflation increases the costs to producing firms, firms prefer to increase their prices aggressively when they face exchange rate shocks. This fact is also supported by worldwide data. The adoption of inflation targeting regimes after 1990s led to reduced inflation in many countries, where ERPT coefficients also decreased significantly. (Arat, 2003)

Froot and Klemperer (1989) investigate how ERPT differs when shocks to the exchange rate are temporary or permanent, using a two period model. In their intertemporal model, ERPT in the second period depends on the market share of the firm in the initial period. Regardless of the degree of competition in the industry, the results indicate that the degree of ERPT is higher when the exchange rate shocks are permanent. In case of temporary shocks, prices can move in any direction; however permanent shocks make firms reflect changes completely to their prices.

According to Mann (1986), ERPT is negatively affected by variability of exchange rates. In an environment where the exchange rates are variable, suppliers already have high profit margins in order to protect themselves against exchange rate risks. In case of exchange rate shocks, they do not increase their prices one-to-one, in order to keep their existing market shares. Instead, they choose to reduce

their profit margins, which are already too high. As a result, ERPT decreases under high exchange rate variability.

The conjecture put forward by Mann is also consistent with the hypothesis that ERPT is lower under floating exchange rate regimes than fixed exchange rate regimes. According to Menon (1995), under floating exchange rate regimes, producer firms prefer to use credit facilities which allow them to postpone their payments until the exchange rates are more advantageous. The deferral of payments lets these firms manage their transactions without reflecting the exchange rate changes on prices, so ERPT is weaker under floating regimes.

Campa and Goldberg (2002) suggest another reason for the negative correlation of exchange rate variability and ERPT. They claim that countries with stable monetary policies and low exchange rate volatility can carry out international transactions easily in their own currency. However, if the monetary policy of a country is unstable, and the currency is volatile, it is harder to make international payments in the local currency. As a result, the countries with volatile currencies often use the other country's currency with their imports, which leads to a reduction of "pricing to market", therefore leads to increased pass-through.

Other macroeconomic factors explaining the differences in ERPT are size of the economy and openness (Alper, 2003). According to McCarthy (1999), small economies have higher pass-through than large economies. Scholars like Ball (1999) and Svensson (1998) claim that openness of the economy reduces size of ERPT. However, there are contrary views. Ho and McCauley (2003) do not find a

significant correlation between the ERPT and openness. Instead, they suggest that a lower level of income leads to a high ERPT.

The last factor affecting ERPT is the macroeconomic policy that the Central Bank pursues (Eichengreen, 2002). If the Central Bank pursues a credible and transparent monetary policy such that it takes the optimal actions in order to meet the pre-announced targets, the agents in the economy recognize that actual inflation does not exceed their inflation expectations. Therefore, as the monetary policy becomes more credible, price setters do not reflect temporary shocks into their prices, which lead to a reduction in ERPT.

2.2.2 ERPT into Domestic Prices

The existing literature defines ERPT in three ways. The first definition is the effect of exchange rate changes on domestic prices of a country, such as Consumer Price Index (CPI) and Wholesale Price Index (WPI). One of the most notable papers in this strand of literature is McCarthy (1999). McCarthy searches for ERPT in some industrialized economies using a VAR model along a distribution chain. In his model, a change in the exchange rate first affects import prices, then it affects producer prices by changing manufacturing costs, and then it affects consumer prices. McCarthy, in his model, analyzes the dynamics of CPI, WPI, import prices and several other variables by estimating supply, demand and exchange rate shocks using Cholesky decomposition. As a result, he finds that the effect of exchange rates on inflation is moderate; however the effect of import prices on inflation is higher.

The methodology of McCarthy is followed by many economists using different data. For example, Bhundia (2002) uses data from South Africa, Garcia and Restrepo (2001) use data from Chile, and Leigh and Rossi (2002) use data from Turkey. Leigh and Rossi find that exchange rates affect prices mostly in the first four months, and the ERPT is completed in the eleventh month. Compared to other developing countries, the ERPT is found to be faster and larger. The authors then claim that the rapidity of ERPT arises from high dollarization, indexation, inflationary expectations and the oligopolistic industrial structure of Turkey. They also claim that the Central Bank of Turkey should improve the monetary transmission mechanism in order to suppress the effects of exchange rate shocks on inflation.

The analysis of Leigh and Rossi, however, is considered by Arat (2003) as inadequate, since his data on oil prices and exchange rates are not appropriate measures of actual market data. For this reason, Arat does the same analysis with Turkish data by modifying the data of Leigh and Rossi, and he finds evidence for complete pass-through in the long run. To compare the pass-through on price measures, Arat separates CPI into two indices: Tradable Goods Price Index and Nontradable Goods Price Index. Comparing the pass-through on these indices and WPI, Arat finds that pass-through on WPI is higher than both components of CPI in the short run. In the long run, pass-through on Tradable Goods component of CPI is higher than WPI, however pass-through on Nontradable Goods component of CPI is the smallest.

There is also another paper on Turkish economy using this methodology. Kara and Öğünç (2005) reestimate the model of McCarthy using Turkish data.

Their analysis differs from Leigh and Rossi, since Kara and Öğünç separate the sample into two: pre-2001 and after-2001. The authors believe that estimating the model without splitting the sample will lead to inaccurate estimates of ERPT. Moreover, Kara and Öğünç indeed aim to emphasize the change in ERPT after the adoption of the floating exchange rate regime. They find out that the completion time of ERPT has decreased after the implementation of the floating exchange rate regime. However, they find that ERPT is still significant, and the dynamics of inflation can be badly affected by ERPT if there are persistent exchange rate shocks.

The paper of Kara and Öğünç is one of the most recent studies on ERPT. However, the authors only have three and a half years of data after the adoption of the floating exchange rate regime. The authors also admit that they need more observations to analyze ERPT under floating exchange rate regime. With more time and data, the price setting behavior of the agents might also improve, which might alter the results in the future.

2.2.3 ERPT into Aggregate and Disaggregated Import Prices

The second definition of ERPT is the effect of exchange rate changes on aggregate import prices, and the third definition of ERPT involves pass-through into disaggregated import prices (such as import prices of a specific sector). One of the recent studies that use these definitions is Campa and Goldberg (2002). Campa and Goldberg analyze the ERPT to aggregate and disaggregated import prices in 25 OECD economies by using an elasticities approach. The authors test

two hypotheses: the first hypothesis is producer currency pricing (PCP) of imports. This hypothesis implies that all the imports are priced in the currency of the exporting country; therefore exporting countries are free to set their own price. In this case, exchange rate changes are fully reflected into prices, therefore there is full ERPT (the elasticity of pass-through is equal to one). The second hypothesis is local currency pricing (LCP) of imports. This hypothesis implies that imports of a country are priced in its own currency, and exchange rate changes do not affect import prices. Therefore, this hypothesis implies no ERPT (the elasticity is equal to zero). Apart from PCP (full pass-through) and LCP (zero pass-through), partial pass-through is also possible. In case of partial pass-through, both PCP and LCP hypotheses are rejected.

As a result of their analysis, Campa and Goldberg are able to reject PCP and LCP; therefore there is partial ERPT in the short run. In the long run, the authors find evidence in favor of PCP, therefore full pass-through exists in the long run. Another striking result is that countries with a higher share of energy and raw materials in their import bundles have a higher pass-through than countries with a higher share of manufacturing and food products. Therefore, Campa and Goldberg prove their claim that import bundle composition of a country is more important than macroeconomic factors in explaining differences in ERPT.

Other studies from this strand are Campa and Minguez (2002) and Türkcan (2005). Türkcan follows the methodology of Campa and Goldberg by using data from Turkey, where he analyzes the ERPT into both aggregated and disaggregated import prices. While the author analyzes import prices, he classifies them as final and intermediate goods prices. Then he tests for PCP and LCP and

finds evidence for PCP instead of LCP in the long run. His results are in line with Leith and Rossi (2002) that ERPT is completed within a year, and most of the ERPT takes place in the first four months following an exchange rate shock. Another important result Türkcan has found is that ERPT is higher with intermediate goods than with final goods. Although not mentioned in his paper; this result brings into mind a policy reform that the dependency of Turkish industry on intermediate goods imports should be reduced in order to decrease ERPT.

Maria-Dolores (2008) also tests the ERPT into intermediate good import prices for several countries in the EU. He finds evidence for high pass-through for intermediate imports in countries like Hungary and Slovenia. ERPT into intermediate good import prices is lower for countries like Cyprus and Slovakia. The author also notes that he cannot estimate the ERPT into Turkish intermediate goods imports due to unavailability of data.

The paper written by Maria-Dolores is one of the most extensive researches on the EU member and candidate countries. The author uses two methodologies in order to analyze ERPT into aggregate and disaggregated import prices, and prices of imported intermediate goods. The first one is Campa and Gonzalez-Minguez (2006) methodology, where the ERPT coefficients are obtained from a difference equation with four lags of the differenced exchange rate and import price. After estimating the ERPT coefficients, the author then tests LCP and PCP hypotheses. The second methodology comes from de Bandt, Banerjee and Kozluk (2007), which estimates the same equation by including an Error Correction Term, as suggested by Engle and Granger (1987). By this way,

ERPT in the long run can be analyzed better. Estimating the equations from these two methodologies, evidence is found for partial pass-through, except Cyprus and Slovenia. For these two countries, evidence is found in favor of full pass-through (PCP). Maria-Dolores also agrees with Campa and Goldberg that manufacturing sectors have lower pass-through compared to raw materials and energy sectors.

Maria-Dolores also includes Turkey as in his analysis an EU candidate country. As a result of the study, no evidence is found for complete ERPT in Turkey, as a contrast to other studies analyzing Turkey mentioned above. Moreover, Turkey has smaller pass-through than most of the other countries analyzed in the sample. Taking account for possible structural breaks (such as the exchange rate regime change), the author also finds that pass-through is higher in sectors where the share of imports is higher.

2.2.4 Other Methodologies for Analyzing ERPT

For Turkish data, Alper (2003) is one of the earliest papers analyzing ERPT. Alper analyzes ERPT in Turkey using a cointegration methodology. He first proves the existence of a cointegration relation between prices and exchange rates, and then he interprets the short and long run dynamics of ERPT estimating an error correction model. As a result, Alper finds evidence for complete ERPT in the long run. Moreover, he also points out that the degree of ERPT varies with "openness" of the price index. In other words, the higher the share of imported goods in the price index, the higher the ERPT into that index becomes. This claim explains why ERPT is found to be higher for WPI than for CPI.

Another paper by Kara et al. (2005) estimate the coefficient of ERPT using two methodologies. The first methodology they apply is based on the question if ERPT coefficients are time varying or constant through time. The authors then estimate the time varying parameters of ERPT into CPI, WPI and their subcomponents using Kalman Filter methodology. They find that the coefficient of pass-through has been declining over time, especially since the adoption of the floating exchange rate regime in 2001. This result is consistent with the view put forward by Taylor (2000) that ERPT is lower under floating exchange rate regimes. Decomposing CPI and WPI into sectors, they also find that ERPT is higher and not declining much for energy and manufactured food sectors. The authors explain this fact by the administration of energy prices by the government, where the government can set prices arbitrarily and reflect the exchange rate changes on prices.

The second methodology that Kara et al. apply is the Seemingly Unrelated Relations (SUR). According to them, a SUR model is superior compared to a VAR model in this case. One reason is that their model is not aggregated enough to use a VAR model. The other reason is that every VAR model is a SUR model with cross equation restrictions, and testing those restrictions will lead to the most appropriate model being used. After estimating ERPT with the SUR model, Kara et al. find that the results are the same with the time varying parameter model. There is evidence that pass-through is zero in the short run, however it is significant and positive in the long run.

According to Kara et al., the decline in the ERPT in the floating exchange rate period is attributed to the decrease in “indexation” behavior of price setting

agents after 2001. In the highly inflationary period before 2001, price setters would index their prices to the changes in exchange rates, in order to protect themselves against risks. Therefore, ERPT used to be very high. However, with decreasing inflation and increasing confidence in the new monetary regime, indexation behavior of agents has significantly decreased, which led to a reduction in ERPT.

There is also a recent strand of research on ERPT which focuses on nonlinear adjustment of prices. Al-Abri and Goodwin (2009) present a threshold cointegration model using data from 16 OECD countries. In this threshold cointegration model, they separate the model into two, depending on the magnitude of exchange rate shocks. The coefficient of ERPT then differs depending on whether the shocks are within a certain range or not. As a result of this analysis, pass-through is found to be higher than estimated in the conventional models. In addition, strong exchange rate shocks lead to a higher degree of ERPT, as expected.

Threshold cointegration models can be used to evaluate all kinds of asymmetries in the ERPT. For example, if the threshold level for the exchange rate is set to be zero, the sample will be divided into two: depreciation and appreciation periods. Then, it will be possible to compare the magnitude of ERPT in these periods, and test whether there is an asymmetry. Silvapulle and Wickremasinghe (2004) analyze asymmetries in ERPT to manufactured import prices in Japan by using the threshold autoregression models developed by Enders and Granger (1998). By testing cointegration under Engle-Granger and Johansen

framework, they find evidence that ERPT is higher during depreciations than during appreciations.

Not all threshold cointegration models take their threshold levels exogenously. Some of them estimate these levels endogenously by "grid search procedures" depending on maximum likelihood methods. By this way, the researchers are not only able to see the differences in depreciation and appreciation periods, but also able to see other types of asymmetries.

Arbatlı (2003) applies a nonlinear model to Turkish data similar to the models mentioned above. She uses a Threshold VAR model in order to model the asymmetries in ERPT. In her model, the threshold values for shocks to exchange rates, industrial production and inflation are determined endogenously. As a result of the analysis, Arbatlı finds out that ERPT is lower when depreciations and economic contractions are stronger, and when inflation is lower.

CHAPTER III

AN OVERVIEW OF TURKISH ECONOMY

3.1 Exchange Rate Regimes in Turkey in 1994-2009

In Turkey, exchange rates were pegged by the Central Bank before 1988. In 1988, it was accepted by the government that exchange rates should be determined under market conditions. To set the exchange rates, daily sessions were run in the Central Bank, where representatives from banks and other financial institutions would also attend. In 1989, Turkish lira was accepted to be fully convertible. As a consequence, private institutions and agents became allowed to make international transfers of foreign currency without limitations.

After the financial crisis of 1994, new laws were enacted where exchange rates began to be determined by the market. The Central Bank could intervene in the exchange rate mechanism though, by the use of monetary policy. In 1994, exchange rates were decided to be the nominal anchor to combat inflation. According to the stand-by agreement signed with the IMF in 1995, exchange rates were arranged to increase one-to-one with monthly rates of inflation. Therefore,

the variability of the real exchange rates was aimed to be minimized. By keeping the real exchange rates stable, the Central Bank intended to protect banks and financial institutions from exchange rate risks, since these institutions had a significant amount of foreign exchange liabilities.

This policy was beneficial not only for banks, but also for the Treasury. The Treasury, having to pay its high domestic debt, would borrow money from the Central Bank. In order to lend money in terms of Turkish lira, the Central Bank would sell foreign exchange to the market in terms of forward contracts. Since these contracts carried high exchange rate risks, these risks had to be reduced by controlling real exchange rate variability.

Exchange rates were used as monetary anchors until 2000. In 2000, the new stand-by agreement made with the IMF required that the rate of inflation should be set as the nominal anchor. Between 1995 and 2000, exchange rate arrangements were being determined according to inflation forecasts. After 2000, it was the exchange rate itself which was adjusted according to the expected inflation, instead of the arrangements. It could be said that the Central Bank replaced its passive monetary policy with an active monetary policy in 2000 (Arat, 2003).

When this new policy was first announced, it was expected that inflation targets would be achieved successfully; therefore real exchange rates would be kept stable. However, in 2000, the inflation target was hugely missed and Turkish lira depreciated. Then it was understood that a fixed exchange rate regime was not suitable for Turkey. Consequently, the Central Bank decided to step out of this

regime gradually. They announced a crawling peg regime for the first eighteen months and a crawling band regime in the next eighteen months. This crawling band regime would aim to keep the exchange rates within the limits of a pre announced band. They also announced that limits of the band would be increased each month, however any movement of exchange rates within the band would be acceptable.

The crawling peg regime was followed for some time; however the crawling band regime could never be adopted, as the liquidity crisis of February 2001 broke out. Because of the "political crisis" and lack of confidence in the exchange rate regime, suddenly there was an excess demand for foreign currency, which led to an upward pressure in the exchange rates. As a result, the Central Bank could not pursue the crawling peg regime any more, and switched to freely floating exchange rate regime.

After February 2001 crisis, bank regulations have become tighter to prevent future crises. Laws have changed such that the Treasury cannot borrow money from the Central Bank directly any more[3]. Most importantly, the Central Bank adopted explicit inflation targeting in 2006 and has been conducting a transparent and credible monetary policy. Since 2001, thanks to these prudent policies, inflation has been brought under control and the exchange rate movements are less variable.

[3] Law Number 4651.

CHAPTER IV

EMPIRICAL ANALYSIS

4. 1 Data

In this thesis, the effect of exchange rate changes on aggregate prices in Turkey is investigated. For this analysis, monthly data are used for the period 1994:01-2009:07. Data for the exchange rates are taken from the Electronic Data Delivery System of the Central Bank of Turkey. Other data are taken from Turkish Statistical Institute Databases. The explanations for the data are given below:

CPI: Logarithm of the Consumer Price Index (1994=100).

WPI: Logarithm of the Wholesale Price Index (1994=100).

EXCH: Logarithm of the arithmetic average of the TL/USD and TL/EURO exchange rates. For the years where TL/EURO exchange rates are not available, TL/DM rate is multiplied by 1.956 for conversion[4].

[4] For the period 1999-2001, where both TL/DM and TL/EURO exchange rates are available, the average ratio between them is 1.956.

INDR: Logarithm of the Industrial Production Index (1997=100). Seasonally adjusted by TRAMO/SEATS Method[5].

IMP: Logarithm of the Import Price Index in dollars, according to SITC Rev. 3 classification (1994=100).

4.2 Methodology: Testing for Asymmetries in ERPT

In the empirical literature, there are many papers testing asymmetries in ERPT. Among them, one of the most significant is Webber (2000). In his paper, Webber analyzes ERPT in seven Asia-Pacific countries, seeks an answer to the question whether ERPT is higher during depreciations. He checks for a cointegration relationship between exchange rates and prices, and finds evidence for asymmetry for six of the seven countries. Most of the papers searching evidence for asymmetry use the notation that he introduced. Webber separates exchange rates into two subsamples, EXCHP (appreciations) and EXCHM (depreciations), whose formulas are given below:

$$EXCHP_t = \sum_{i=1}^{t} I_t (EXCH_t - EXCH_{t-1}) \tag{4.1}$$

$$EXCHM_t = \sum_{i=1}^{t} (1 - I_t)(EXCH_t - EXCH_{t-1}) \tag{4.2}$$

[5] TRAMO/SEATS is a seasonal adjustment method introduced by Gómez and Maravall at the Bank of Spain, and promoted by the Eurostat. TRAMO estimates selected series as ARIMA models according to BIC criteria. After linearizing the series, SEATS method decomposes these series as trend-cycle and seasonally adjusted components by Wiener and Kolmogorov Filter.

where I_t is a binary variable defined as:

$$I_t = \begin{Bmatrix} 1 & if\ \ EXCH_t > EXCH_{t-1} \\ 0 & otherwise \end{Bmatrix} \tag{4.3}$$

Note that, by definition, $EXCHP_t \geq 0$ and $EXCHM_t \leq 0$, $\forall t \in N$. When there is a depreciation of the currency EXCHP will increase, and when there is an appreciation EXCHM will decrease. In the existing ERPT literature, it is accepted that depreciations lead to increases in prices, whereas appreciations lead to decreases in prices. Therefore we expect to find a positive correlation both between prices and depreciations (EXCHP), and between prices and appreciations (EXCHM).

4.3 Testing for Stationarity

Before analyzing the relationship between exchange rates and prices, the time series properties of all the variables should be checked. Table 4.1 gives the results for ADF tests applied to these variables. Lag lengths are determined automatically by E-views according to Schwarz Information Criteria. The test results cannot reject the hypothesis that all variables are I(1), at 5% level.

Table 4.1. ADF Test Results

Null Hypothesis:	I(1) in Levels		I(1) in First Differences	
	t-Statistic	Lag Length	t-Statistic	Lag Length
CPI	-1.485	1	-9.355*	0
WPI	-1.276	1	-6.245*	0
EXCH	-0.195	2	-6.175*	2
EXCHP	-1.017	3	-6.465*	2
EXCHM	-1.285	6	-85.29*	0
INDR	-2.684	1	-19.369*	0
IMP	-1.299	0	-13.13*	0

* indicates rejection of the null hypothesis at 5% level.

4.4 Model Specification and Estimation

According to Goldberg and Knetter (1997), a conventional model analyzing ERPT into aggregate prices is of the form:

$$P_t = \beta_0 + \beta_1 IMP_t + \beta_2 EXCH_t + \beta_3 Z_t + \varepsilon_t \quad (4.6)$$

where P_t , IMP_t , $EXCH_t$ and Z_t denote aggregate prices, import prices, exchange rates and other control variables (such as industrial production or output gap) respectively.

Since all variables are found to be I(1), this suggests that there might be cointegrating relationship among them. In order to check whether (4.6) is the correct specification for our model, the Johansen (1988) procedure is applied. Two VAR models are estimated. The first model includes variables CPI, EXCHP, EXCHM, INDR, IMP. The second model includes variables WPI, EXCHP,

EXCHM, INDR, IMP. Then, these models are tested for possible cointegration relations, using Trace and Maximum Eigenvalue Test statistics. Table 4.2 shows the results. According to Trace Test, both Model I and Model II have one cointegrating equation each at 1% level. Likewise, according to Maximum Eigenvalue Test, Model I has one cointegrating equation at 5% level and Model II has one cointegrating equation at 1% level. These test results imply that, at the confidence level of 1%, there is a unique equation for each model that shows the cointegration relation between these variables.

Table 4.2 Johansen Cointegration Tests[6]

	Null Hypothesis: # of Cointegrating Equations	**Alternative Hypothesis: # of Cointegrating Equations**	**Model I (CPI)**	**Model II (WPI)**
Trace Test Statistic (p-value)	Zero	One	125.552** (0.000)	116.564** (0.000)
	One	Two	54.251* (0.011)	52.526* (0.017)
	Two	Three	31.840* (0.029)	24.696 (0.173)
Max. Eigenvalue Test Statistic (p-value)	Zero	At Least One	71.301** (0.000)	64.038** (0.000)
	One	At Least Two	22.410 (0.200)	27.830* (0.047)
	Two	At Least Three	15.799 (0.237)	12.368 (0.512)

* indicates rejection of the null hypothesis at 5% level.
** indicates rejection of the null hypothesis at 1% level.

[6] MacKinnon-Haug-Michelis (1999) p-values are given in parentheses. See Johansen (1991) for test details.

Having enough evidence that these variables are cointegrated, now it has to be determined which variables are exogenous and which are endogenous. For this reason, weak exogeneity tests are performed on both models. The results show that industrial production and import price indices are weakly exogenous at 5% level, appreciations (EXCHM) and depreciations (EXCHP) are weakly exogenous at 1% level, but CPI and WPI are not weakly exogenous even at 1% level. This result indicates that these models do not need to be estimated in a system. They can rather be expressed in single equations, as evidence was found in favor of one cointegration relation for each system, at 1% confidence level. Moreover, for each model, price indices are endogenous, whereas the other variables are weakly exogenous. These findings prove that the specification suggested in (4.6) is suitable for our model.

Table 4.3 Weak Exogeneity Tests[7]

		Log (Price Index)	**Log (EXCHP)**	**Log (EXCHM)**	**Log (INDR)**	**Log (IMP)**
Model I (CPI)	LR Test Stat	48.831**	6.187*	0.554	1.415	0.534
	p-value	0.000	0.013	0.457	0.234	0.465
Model II (WPI)	LR Test Stat	32.478**	3.176	5.249*	1.284	1.697
	p-value	0.000	0.074	0.022	0.257	0.193

* indicates rejection of the null hypothesis at 5% level.

** indicates rejection of the null hypothesis at 1% level.

[7] LR test statistics have chi-square distribution with 1 degree of freedom. The null hypothesis of the test is that the selected variable is weakly exogenous to the estimated model. See Johansen (1995) for test details.

After making sure that the model specification is appropriate, the two equations below are estimated, and cointegration is also tested according to Engle-Granger (1987) two step procedure.

$$CPI = \beta_0 + \beta_1 EXCHM + \beta_2 EXCHP + \beta_3 INDR + \beta_4 IMP + \varepsilon_t \quad (4.7)$$

$$WPI = \theta_0 + \theta_1 EXCHM + \theta_2 EXCHP + \theta_3 INDR + \theta_4 IMP + \nu_t \quad (4.8)$$

Table 4.4 shows the estimation results. All the estimated coefficients (except the coefficient of import price, which is not even significant at 1% level) are significant at 5% level. To check whether these estimates are meaningful, ADF unit root tests are applied to residuals. For both equations, evidence is found that the residuals are I(0) at 5% level, so the variables are cointegrated and the regressions are not spurious. In order to detect asymmetries, the null hypotheses $\hat{\beta}_1 = \hat{\beta}_2$ and $\hat{\theta}_1 = \hat{\theta}_2$ are tested in equations (4.7) and (4.8) respectively. Since both of these null hypotheses are rejected at 5% level, there is evidence for asymmetry in ERPT. In line with the claims above, depreciations lead to a higher ERPT compared to appreciations.

Table 4.4 Estimation Results (1994:02-2009:07)

Dep. Var.	Coefficient Estimates					Wald Test (Null Hypothesis: Symmetry)	Residual Unit Root Test
	Intercept	EXCHP	EXCHM	INDR	IMP	F-Statistic (1,181)	t-Statistic
CPI	5.929* (0.000)	0.901* (0.000)	0.015* (0.000)	0.481* (0.000)	0.02 (0.707)	11230.47**	-8.072**
WPI	5.344* (0.000)	0.870* (0.000)	0.013* (0.000)	0.499* (0.000)	0.165* (0.002)	10847.59**	-9.284**

* indicates significance of coefficients at 5% level.

** indicates rejection of the null hypothesis at 5% level.

Kara and Öğünç (2005) find that the magnitude of ERPT diminished after the floating exchange rate regime was accepted in 2001. This finding is tested on our data by applying structural break tests to the estimated equations (4.7) and (4.8). In order to see whether the amount of ERPT has changed after 2001, Chow Breakpoint Test is applied to the estimated regressions (4.7) and (4.8). The results suggest at 5% level that the coefficients of these equations do not remain the same after 2001. Therefore, we decide that the sample must be separated into two, and cointegration analyses must be done separately to these subsamples. By this way, we will be able to see whether the strength of ERPT has decreased after 2001.

Table 4.5 Chow Breakpoint Test Results

Equation:	F-Statistic (5,176)	p-value
(4.7)	5.307	0.000
(4.8)	10.796	0.000

Null Hypothesis: No Structural Break in February 2001

4.5 Exchange Rate Pass-through for 1994-2000

When data is analyzed for 1994-2000, it is observed that lira depreciated continually. In those seven years, there are only four months that appreciation of lira took place. The unavailability of enough appreciation periods for lira makes it impossible to construct a meaningful variable for appreciations (see the variable named LEXCHM in the appendix, which has the value of -0.058 for the entire period 1994:06-2001:04). Since EXCHM has a constant value during most of the time, a unit root test cannot be conducted on it for the subsample of 1994-2000.

For analyzing asymmetries, an alternative way to proceed is to replace appreciations (EXCHM) in (4.7) and (4.8) with exchange rate (EXCH) itself, but this time the high correlation between exchange rate changes and appreciations leads to a collinearity problem between EXCH and EXCHM (since most of the exchange rate movements in this period are composed of depreciations). Therefore, the only possible option is to exclude appreciations from the analysis. Then, unfortunately, due to the lack of appreciation data in the model, we will not be able to observe asymmetries in the ERPT for 1994-2000. Equations (4.7) and (4.8) become:

$$CPI_t = \beta_0 + \beta_1 EXCHP_t + \beta_2 INDR_t + \beta_3 IMP_t + \varepsilon_t \tag{4.9}$$

$$WPI_t = \theta_0 + \theta_1 EXCHP_t + \theta_2 INDR_t + \theta_3 IMP_t + \nu_t \tag{4.10}$$

Table 4.6 suggests that the residuals of these estimated regressions are I(0) at 5% level, therefore there is evidence for a cointegration relation for equations

(4.9) and (4.10). In these equations, all the estimated coefficients are significant at 5% level.

Table 4.6 Estimation Results for the Subsample 1994:01-2000:12

Dependent Variable	**Coefficient Estimates**				**Residual Unit Root Test (ADF)**
	Intercept	EXCHP	INDR	IMP	t-Statistic
CPI	9.146* (0.000)	0.77* (0.000)	1.024* (0.000)	-1.25* (0.000)	-5.553**
WPI	7.378* (0.000)	0.723* (0.000)	1.118* (0.000)	-0.932* (0.000)	-4.703**

* indicates significance of coefficients at 5% level.

** indicates rejection of the null hypothesis at 5% level.

The coefficients of depreciations are 0.770 and 0.723 for (4.9) and (4.10) respectively. Since all the variables are in logarithms, these coefficients actually indicate the elasticities of price indices (CPI and WPI) with respect to exchange rates, hence they indicate the *magnitude* of ERPT. In particular, ERPT into CPI is found to be 77% and ERPT into WPI is 72.3%.

Using these magnitudes of pass through, we can also test the hypotheses defined as Producer Currency Pricing (PCP) and Local Currency Pricing (LCP). PCP requires that the elasticity of price level with respect to the exchange rate is equal to one. Therefore, any change in exchange rates is fully reflected to prices according to PCP. In contrast, LCP requires that exchange rate changes do not affect prices at all. To search evidence for PCP hypothesis, we test if $\beta_1=1$ in (4.9)

and if $\theta_1=1$ in (4.10). Similarly, to check for LCP we test whether these coefficients are zero. Table 4.7 shows that these hypotheses are strongly rejected for both consumer and wholesale prices. As a result, there is evidence for partial pass-through.

Table 4.7 Wald Tests for PCP and LCP Hypotheses (1994:01-2000:12)

	F Statistics (p-values)	
	Null Hypothesis: PCP	Null Hypothesis: LCP
(4.9)	79.533 (0.000)	895.589 (0.000)
(4.10)	155.503 (0.000)	1055.937 (0.000)

These coefficients in Table 4.6 give us the long run estimates of ERPT. To analyze the short run dynamics of ERPT, error correction model for the above equations must be estimated.

$$\Delta CPI_t = \alpha + \sum_{i=1}^{k-1} \mu_i \Delta CPI_{t-i} + \sum_{i=1}^{k-1} \delta_i \Delta EXCHP_{t-i} + \sum_{i=1}^{k-1} \gamma_i \Delta INDR_{t-i} + \sum_{i=1}^{k-1} \phi_i \Delta IMP_{t-i} + \varphi \varepsilon_{t-1} + \iota_t \quad (4.11)$$

$$\Delta WPI_t = \lambda + \sum_{i=1}^{l-1} \vartheta_i \Delta WPI_{t-i} + \sum_{i=1}^{l-1} \eta_i \Delta EXCHP_{t-i} + \sum_{i=1}^{l-1} \tau_i \Delta INDR_{t-i} + \sum_{i=1}^{l-1} \kappa_i \Delta IMP_{t-i} + \psi \nu_{t-1} + \gamma_t \quad (4.12)$$

where ε_{t-1} and v_{t-1} are lagged residuals from (4.9) and (4.10) respectively, and *k* and *l* are optimal lag lengths. According to Akaike Information Criteria, lag lengths are estimated to be 2 for both equations.

In Table 4.8, estimation results of (4.11) are given. The coefficient of lagged depreciations ($\Delta EXCHP_{-1}$) is 0.099, which is significant at 5% level. This means that the short run ERPT into consumer prices during depreciations is 9.9%. Error correction term is estimated to be 0.002, though it is insignificant. This implies that adjustment to the long run equilibrium is extremely slow.

Table 4.8 Error Correction Model Estimates (Dependent Variable: ΔCPI)

Dependent Variable: ΔCPI	**Coefficient**	**t-Statistic**	**Prob.**
Intercept	0.042*	6.846	0.000
Δ(CPI(-1))	-0.037	-0.268	0.790
ΔEXCHP(-1)	0.099*	4.326	0.000
ΔINDR(-1)	0.048	0.810	0.421
ΔIMP(-1)	0.083	1.081	0.283
Error Correction Term	0.002	0.106	0.916

* indicates significance of coefficients at 5% level.

In Table 4.9, the coefficients from the estimation of (4.12) can be seen. The coefficient of lagged depreciations is 0.123, which is significant at 5% level. Therefore, the short run ERPT into wholesale prices during depreciations is 12.3%. Error correction term is estimated to be -0.091, which is also significant at 5% level.

Table 4.9 Error Correction Model Estimates (Dependent Variable: ΔWPI)

Dependent Variable: ΔWPI	Coefficient	t-Statistic	Prob.
Intercept	0.027*	7.657	0.000
Δ(WPI(-1))	0.190*	2.891	0.005
ΔEXCHP(-1)	0.123*	8.718	0.000
ΔINDR(-1)	-0.040	- 0.871	0.236
ΔIMP(-1)	0.029	0.476	0.790
Error Correction Term	-0.091*	-4.740	0.000

* indicates significance of coefficients at 5% level.

Comparing the short run elasticities for consumer and wholesale prices, we find out that in the short run ERPT is higher for wholesale prices. The adjustment coefficient, which indicates the rate of convergence, is not significant for (4.11), however it is significant and negative for (4.12).

4.6 Exchange Rate Pass-through for 2001-2009

For the floating exchange rate regime period, the same procedure with above is repeated by including appreciations (EXCHM) into the analysis. Equations (4.7) and (4.8) are estimated first, and cointegration is tested using Engle-Granger two step method. The results are given in Table 4.10.

Table 4.10 Estimation Results for the Subsample 2001:03-2009:07

Dep. Var.	Coefficient Estimates					Wald Test (Null Hypothesis: Symmetry)	Residual Unit Root Test
	Intercept	EXCHP	EXCHM	INDR	IMP	F-Statistic (1, 96)	t-Statistic
CPI	5.490* (0.000)	0.305* (0.000)	-0.117 (0.179)	0.879* (0.000)	-0.312* (0.000)	56.967**	-3.243**
WPI	4.748* (0.000)	0.383* (0.000)	0.077 (0.545)	1.091* (0.000)	-0.347* (0.000)	13.785**	-3.381**

* indicates significance of coefficients at 5% level.

** indicates rejection of the null hypothesis at 5% level.

ADF Unit Root Tests confirm that the cointegration relationship exists between these variables. In equation (4.7), all the coefficients except EXCHM are significant at 5% level. The insignificance of the coefficient of EXCHM implies that there is no ERPT on consumer prices during appreciations. However, during depreciations there is 30.5% pass-through on consumer prices. The existence of an asymmetry is also proved by the Wald Test, where the ERPT coefficients for appreciations and depreciations are rejected to be equal, at 5% level.

In equation (4.8), all coefficients except EXCHM are significant at 5% level. Analyzing the estimated coefficients, we see that there is an asymmetry here as well, since depreciations imply 38.3% pass-through and appreciations imply no pass-through on wholesale prices. To further ensure asymmetry, Wald Test is also applied. The results indicate that the null hypothesis of symmetry is strongly rejected, so asymmetry exists for ERPT into wholesale prices.

Using these estimated coefficients, which actually indicate elasticities, we can test for PCP and LCP hypotheses for the floating exchange rate period. For depreciations, if there is complete pass-through (PCP), then β_2=1 and θ_2=1 must hold in (4.7) and (4.8) respectively. If there is zero pass-through (LCP), then both these coefficients must be zero. In the same way, for appreciations, PCP requires that β_1=1 and θ_1=1 hold, and LCP requires β_1=0 and θ_1=0. Table 4.11 shows the test results for these hypotheses. For depreciations, both PCP and LCP are rejected at 5% level. For appreciations, PCP is rejected but LCP cannot be rejected at 5% level.

The hypotheses PCP and LCP can also be tested jointly on depreciations and appreciations. The joint test for PCP has null hypothesis that β_1=1 and β_2=1 for equation (4.7), and that θ_1=1 and θ_1=1 for equation (4.8). Similarly, the joint test for LCP has null hypothesis that β_1=0 and β_2=0 for equation (4.7), and that θ_1=0 and θ_2=0 for equation (4.8). The test results imply that these joint tests are all rejected at 5% level, therefore there is no evidence for local or producer currency pricing. As there is neither complete nor zero pass-through, it can be said that there is partial pass-through into both consumer and wholesale prices.

Table 4.11 Wald Tests for PCP and LCP Hypotheses (2001:03-2009:07)

	Depreciations		Appreciations		Joint	
	PCP	LCP	PCP	LCP	PCP	LCP
F-Statistic df(1,96) for Eq(4.7)	393.740 (0.000)	75.696 (0.000)	167.454 (0.000)	1.829 (0.179)	286.650 (0.000)	318.023 (0.000)
F-Statistic df(1,96) for Eq(4.8)	142.795 (0.000)	54.993 (0.000)	52.622 (0.000)	0.370 (0.545)	115.901 (0.000)	151.014 (0.000)

Note: p values are given in parentheses

The coefficients above give us the long run estimates of ERPT. To analyze the short run dynamics of the cointegration relations, error correction form of (4.7) and (4.8) are constructed. These equations have the form:

$$\Delta CPI_t = \alpha + \sum_{i=1}^{k-1} \mu_i \Delta CPI_{t-i} + \sum_{i=1}^{k-1} \zeta_i EXCHM_{t-i} + \sum_{i=1}^{k-1} \delta_i EXCHP_{t-i} + \sum_{i=1}^{k-1} \gamma_i INDR_{t-i} + \sum_{i=1}^{k-1} \phi_i IMP_{t-i} + \varphi \varepsilon_{t-1} + \iota_t \quad (4.13)$$

$$\Delta WPI_t = \lambda + \sum_{i=1}^{l-1} \vartheta_i \Delta WPI_{t-i} + \sum_{i=1}^{l-1} \omega_i EXCHM_{t-i} + \sum_{i=1}^{l-1} \eta_i EXCHP_{t-i} + \sum_{i=1}^{l-1} \tau_i INDR_{t-i} + \sum_{i=1}^{l-1} \kappa_i IMP_{t-i} + \psi \nu_{t-1} + \gamma_t \quad (4.14)$$

For both (4.13) and (4.14), Akaike Information Criteria suggest that optimal lag length is 2. Estimation results of (4.13) in Table 4.12 show that in the short run, the coefficients of lagged exchange rate changes are insignificant at 5% level. Therefore, there is no evidence for pass-through in the short run for consumer prices. The error correction coefficient, however, is significant, and is -

0.053. This implies that the rate of convergence has increased in the floating exchange rate period, compared to the previous subsample.

Table 4.12 Error Correction Model (Dependent Variable: ΔCPI)

Variable	Estimate	t-Statistic	Prob.
Intercept	0.005*	3.613	0.001
Δ(CPI(-1))	0.610*	9.636	0.000
ΔEXCHP(-1)	-0.014	-0.660	0.511
ΔEXCHM(-1)	0.076	1.346	0.182
ΔINDR(-1)	-0.012	-0.951	0.344
ΔIMP(-1)	0.051	1.382	0.170
Error Correction Term	-0.0525*	-2.342	0.021

* indicates significance of coefficients at 5% level.

Estimation Results for (4.14) are given in Table 4.13. Similar with above results, the coefficient of EXCHM is insignificant at 5% level. However, the coefficient of EXCHP is positive and significant. There is evidence for 9.7% short run pass-through into wholesale prices. The error correction coefficient is estimated to be -0.053, which is significant at 5% level. Comparing these error correction term coefficients for consumer and wholesale price indices, it could be concluded that the rates of convergence are quite close for CPI and WPI; however WPI adjusts a little faster towards the equilibrium then CPI. In addition to these results, we also observe that the error correction term for wholesale prices is smaller for the sample after 2001. This indicates that the rate of adjustment has decreased for WPI; therefore ERPT into WPI has slowed down after 2001.

Table 4.13 Error Correction Model (Dependent Variable: ΔWPI)

Variable	Estimate	t-Statistic	Prob.
Intercept	0.003	1.579	0.118
Δ(WPI(-1))	0.655*	10.673	0.000
ΔEXCHP(-1)	0.097*	3.370	0.001
ΔEXCHM(-1)	0.152	0.083	0.071
ΔINDR(-1)	-0.056	-0.926	0.357
ΔIMP(-1)	0.099	1.967	0.052
Error Correction Term	-0.0533*	-2.389	0.019

* indicates significance of coefficients at 5% level.

4.7 Estimation Results

So far, the presence of cointegration between prices and exchange rates are proved. Asymmetries in ERPT during appreciation and depreciation periods are illustrated; long run and short run dynamics of ERPT are modeled. In this section, the magnitude of ERPT will be compared for both exchange rate regimes: crawling peg and floating exchange rate.

For the whole sample, 1994:01-2009:07, it is estimated that one percent depreciation of lira leads to 0.90% increase in CPI, and 0.87% increase in WPI. For the period before 2001, the elasticities of CPI and WPI for depreciations are 0.77 and 0.72 respectively. For the period after 2001, these elasticities fall down to 0.30 and 0.38. Given the fact that these elasticities display the magnitude of

ERPT, it is observed that the magnitude of ERPT during depreciations has significantly decreased after 2001.

For the whole sample, the elasticities of CPI and WPI for appreciations are 0.015 and 0.013. For the period 1994:02-2000:12, we cannot estimate the elasticity of prices to appreciations, since we do not have enough data for appreciations (the variable EXCHM is constant for most of the time). For the floating exchange rate regime period, the coefficients of ERPT into CPI and WPI are insignificant for depreciations. This means that, for 2001:03-2009:07, we cannot reject the hypothesis that appreciations do not lead to any reduction in prices.

The findings above indicate long run elasticities of ERPT. For the short run, pass-through coefficients are found by the error correction model estimates. For the period before 2001, short run elasticities of CPI and WPI during depreciations are 0.099 and 0.123 respectively. For the period after 2001, the ERPT coefficient of depreciations into CPI is not significant. For WPI, the rate of ERPT is 9.7%. These results imply that, for depreciations, the magnitude of short run ERPT has also decreased after 2001.

These results are consistent with Kara et al. (2005) that the magnitude of ERPT has diminished after 2001 for both short run and long run. Kara et al. also find that the decline in ERPT after 2001 is higher for CPI compared to WPI. We obtain the same result for depreciations, since the ERPT into CPI decreases more than the ERPT into WPI after 2001. Kara et al. explain the decrease in ERPT after 2001 by the adoption of the floating exchange rate regime after 2001. However, in

the literature, there are also other explanations for this decline. For example, evidence is found that ERPT has also decreased in other developing economies in the recent years. Most studies attribute this decline in ERPT to the adoption of the inflation targeting regime[8]. This is also in line with the hypothesis put forward by Taylor (2000), that a lower inflationary environment will reduce exchange rate pass-through.

In Turkey, during the years 2002-2005, an implicit inflation targeting regime was followed. After the necessary conditions were met and inflation was partly brought under control, the inflation targeting regime was announced in 2005 and has been followed explicitly since then. Since the inflation has been brought under control after the adoption of the inflation targeting regime, it could be said that the success of the inflation targeting regime and the reduced inflation in Turkey played a major role in the decline of ERPT after 2001.

Another possible explanation put forward by Kara et al. (2005) is that the adoption of IT regime increased the credibility of the Central Bank. As a result, depreciations do not lead to high inflationary expectations any more, and therefore pass-through is not large. Studies by Eichengreen (2002) and Mishkin and Savastano (2001) are also in accordance with this view.

There are also other explanations for the decline in ERPT in developing countries. Kara et al. suggest that the decline in the "indexation" mechanism after 2001 played a role in the reduction in ERPT. This mechanism could be explained

[8] The study by Junior (2007) shows the decline in ERPT after the adoption of IT regime in Brazil, Mexico, South Korea, South Africa and Czech Republic. Studies on other developing countries are also cited in this paper.

as follows: The high dependence of Turkish economy on imported intermediate goods in the manufacturing industry, and the low substitutability of these imports with domestic goods made Turkish economy highly susceptible to exchange rate shocks. Any depreciation was fully reflected in prices of the imported intermediate and final goods. As a result, any change in exchange rates used to increase the inflation expectations, and therefore wages and prices were adjusted according to this expected inflation. This adjustment mechanism was named “indexation” by Montiel and Ostry (1993). In Turkey, the reduction in inflationary expectations after the recovery from 2001 crisis has led to the weakening of the indexation mechanism, which has led to the decline in ERPT.

Although long run ERPT has diminished after 2001, another study by Kara and Öğünç (2005) find that the cumulative effects of pass-through in the short run are quite large. Moreover, Kara and Öğünç claim that the total pass-through would be more significant if the shocks to the exchange rates were one-sided and persistent. In this thesis, this argument is not supported. The cumulative effects of exchange rate shocks are not found to be high, even when the shocks are persistent. The difference in the results might stem from the fact that Kara and Öğünç have only three and a half years of data after 2001. In this thesis, a longer data set is used, which might have altered the results.

Another result from this analysis is that in the short run, the degree of pass-through for WPI is higher than for CPI. In the long run, for the sample before 2001, ERPT is higher for CPI than for WPI, although both are quite high. After 2001, the degree of ERPT becomes higher for WPI than CPI. These results are roughly consistent with the findings of the previous literature. Leigh and Rossi

(2002), Arat (2003), Arbatlı (2003), and Kara and Öğünç (2005) all find that pass-through is higher for WPI. Alper (2003) explains this finding by the differences in the components of CPI and WPI. Prices of services, which have an important weight in consumption basket, are included in CPI, whereas they are not included in WPI. Since most of these services are nontradable, exchange rate changes are less likely to be reflected on the prices of services, compared to tradable goods prices. Therefore, any price index which has a higher weight of tradables will exhibit a higher rate of pass-through. This is the reason why pass-through into WPI is higher than pass-through into CPI.

CHAPTER V

CONCLUSION

In this thesis, exchange rate pass-through in Turkey is analyzed using an asymmetric cointegration approach. The relationship between prices and exchange rates are modeled in a reduced-form equation instead of a general equilibrium setting where supply and demand determine prices in all markets. First, Johansen (1988) procedure is implemented to see whether there is a cointegration relationship between price series and exchange rates. Then, in order to specify the correct model for the relationship between exchange rates and prices, weak exogeneity status are tested for the variables. After the correct model is specified, the existence of asymmetric cointegration is tested using the Engle-Granger (1987) two-step cointegration method. As a result of the analysis, evidence is found for an asymmetric cointegration relationship between exchange rates and prices. By testing the asymmetries in ERPT, it is shown that depreciations lead to a higher degree of pass-through compared to appreciations.

By applying a structural change test, it is detected that there exists a structural break in the model in 2001. In fact, this structural break arises from the

effect of 2001 crisis on Turkish economy. In April 2001, following the crisis, new laws were enacted in order to increase credibility and transparency of the monetary policy regime. These laws stated that the main goal of the Central Bank is to ensure price stability. It was also asserted that the Central Bank was the only institution responsible from the implementation of the monetary policy. Therefore, the Central Bank was let freely determine which tools to use and actions to take. Moreover, the new laws indicated that the Treasury and other public institutions were forbidden to borrow money from the Central Bank directly. These laws together acquired the independence of the Central Bank legally. As a result, the credibility of the monetary policy increased, which restrained the inflationary expectations after 2001.

After 2001 crisis, the crawling peg regime was abolished and the floating exchange rate regime was adopted. The adoption of the floating exchange rate regime and the developments above provoked a significant decrease in inflation. After inflation was brought under control and the necessary economic conditions were met, the Central Bank announced that explicit inflation targeting regime was going to be followed. The success of the inflation targeting regime and the monetary policy actions taken by the Central Bank gave rise to increasing confidence in the economy. An independent and a credible Central Bank, a successful monetary policy and the low inflationary environment together improved the conditions in Turkish economy, which weakened the relationship between exchange rates and prices.

In this thesis, it is found that the degree of exchange rate pass-through has significantly decreased after 2001, both in the short and the long run. This

decrease in pass-through is mostly due to the reduction in inflation and the improving conditions in Turkish economy after the floating exchange rate regime was accepted. Since confidence in the new regime has increased, and inflation has been brought under control, price-setting agents gradually gave up their "indexation" behavior. As a result, pricing began to be made more often in the local currency, which decreased the effects of exchange rate shocks on prices.

Yet, it could also be argued that the low inflationary environment in Turkey in the recent years is due to the inexistence of strong exchange rate shocks. When the movements of exchange rates are analyzed, it is observed that Turkish lira has not depreciated much since 2001. In addition, there are even some periods that lira has appreciated, which did not happen much before 2001. As we have found that depreciations generate a higher pass-through than appreciations, the lack of strong depreciations might have caused the low inflation in Turkey. As a result, monetary policy makers should still make account for the ERPT when they set their inflation targets. Even though it is low and has decreased since 2001, exchange rate shocks still have a positive effect on prices and inflation.

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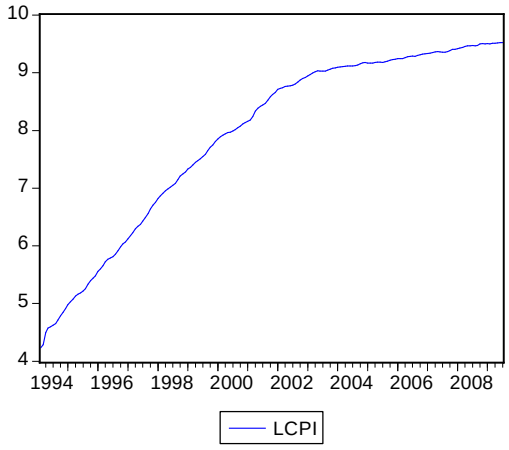
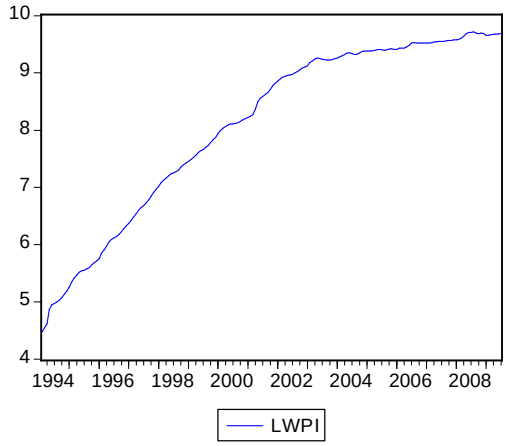
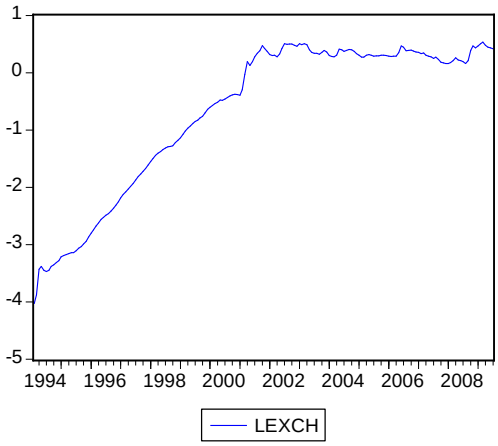
APPENDIX

Time Series Charts of the Variables (in Logarithms)



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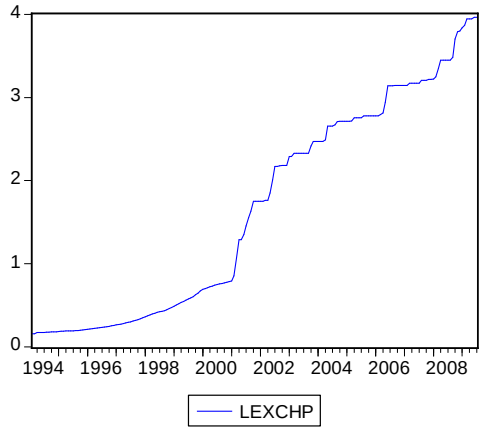
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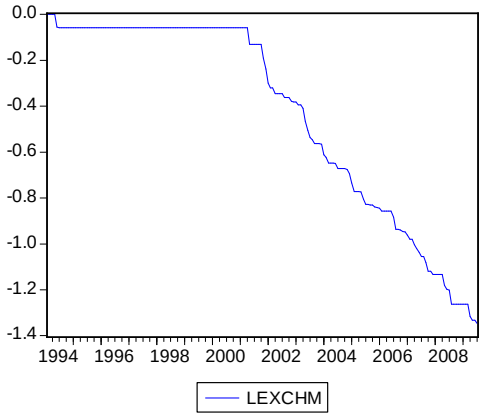
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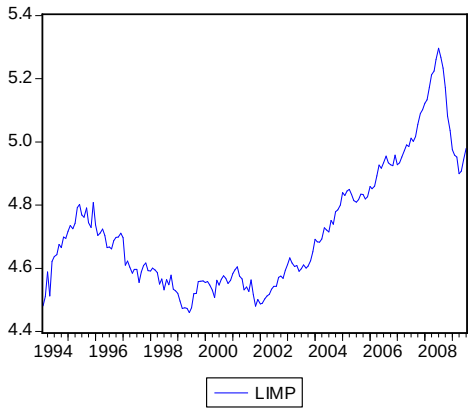
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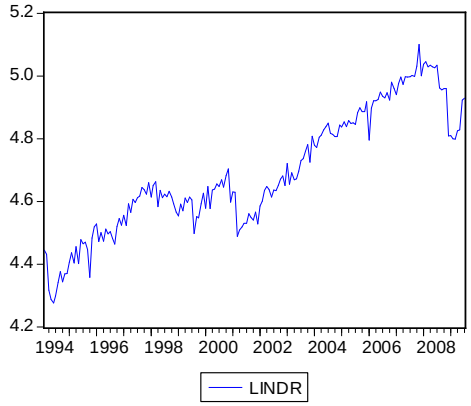
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