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The Turkish Downstream Petroleum Industry – Analysis of Market Efficiency

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Master Thesis within the main profile of Energy, Natural Resources & Environment

NORGES HANDELSHØYSKOLE

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ABSTRACT

The process of liberalization is shaping the policies of governments regarding the key sectors such as energy. Turkey has also gone through these processes and the current downstream petroleum market is considered to be liberal with one private refinery and many players in petroleum products retail market. In this paper, pricing mechanisms and market structure in the Turkish downstream petroleum industry will be investigated in detail focusing on the period between 2007 and 2009. In order to conduct such analysis, market efficiency will be analyzed in detail by applying econometric tools to test for asymmetric price patterns if there exists between crude oil prices and fuel prices in Turkey. The aim of this paper is to draw a general picture of the current market as well as looking at the market developments and analyzing the pricing mechanisms in the sector via taking into account the margins and pricing behaviors of players by applying different methodologies combining with comparative analysis.

PREFACE

This thesis is written within the Master of Science in Economics and Business Administration.

In an effort to contribute to the research community in resource economics and bring attention to the pricing asymmetries and market inefficiencies, we have investigated the Turkish downstream petroleum industry in an attempt to analyze the market structure and test its efficiency through analysis of asymmetrical pricing transformations from upstream to downstream petroleum markets. To complement this analysis, an empirical study was conducted using weekly price data of Brent crude oil prices and pump prices of fuel in Turkey during a three-year-period. The empirical tests are considered statistically strong thanks to the sufficient amount of data.

The unique characteristics of the petroleum industry as a vertically integrated sector with price transmissions on different levels and monopoly position of the refiner in the Turkish downstream petroleum industry have motivated us to study these features and their impact on the market efficiency; a subject of interest to the different stakeholders in the petroleum industry.

We here acknowledge our much felted gratitude and thanks to our supervisor, Røgnvaldur Hannesson, for the valuable comments and guidance. Besides, we would like to thank Norwegian School of Economics to open research areas for the researchers interested in energy, resource and environmental economics through ENE master program.

We would like also to address our thanks to our family and friends for their support.

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1. INTRODUCTION

1.1 Background

The Turkish downstream petroleum industry has encountered many structural changes since the foundation of republic. The latest radical structural change was privatization of state-owned refinery TUPRAS and the enactment of new Turkish Petroleum Law to be considered as deregulation of the petroleum market. TUPRAS was a state monopoly until 26 January 2006 and then it was privatized and now it is operated by KOC Company.

After the privatization of state-owned monopoly TUPRAS, petroleum product prices have been determined by market forces. However the monopoly position of TUPRAS has not been changed since all the refineries in Turkey are operated by TUPRAS. Moreover market structure would be explained as many buyers (retailers) and one supplier (TUPRAS). Thus the price mechanisms and market structure are considered to be exceptional in that sense and crucial to be researched on, in detail.

Our interest in the Turkish petroleum industry is particularly in the market efficiency of the downstream petroleum market in recent years (2007-2009) in order to examine how privatization of the state monopoly TUPRAS has affected the pricing mechanisms and market structure. It is interesting to analyze the possible pricing asymmetries in Turkish downstream market due to the monopoly position of the refinery. Additionally, there had been an increasing public concern regarding high petroleum product prices in Turkey. It is claimed that these high prices are a result of asymmetrical price adjustments in the downstream petroleum sector. It is highly criticized that downward movements in crude oil prices are not transmitted to the petroleum product prices as much and as fast as the upstream movements in crude oil prices. Thus it is important to conduct an empirical analysis in order to contribute to these discussions and the relevant academic research areas.

There has been an increasing interest among researchers in analyzing pricing asymmetries caused by market inefficiencies, especially in European petroleum markets. Bacon (1991) initiated the asymmetrical price adjustment analysis with his paper on UK gasoline market continued with Manning (1991) and Reilly and Witt (1998). Kirchgässner and Kübler (1992) analyzed the German market and Contín-Pilart et al. (2008) investigated the Spanish retail market of gasoline via testing for possible pricing asymmetries.

The main objective of this thesis is to examine and analyze the Turkish downstream petroleum market and the efficiency of it via the empirical analysis of possible pricing asymmetries in order to examine the factors behind the disturbances of market efficiency.

1.2 Target and purpose

The targeted audience of this paper is mainly researchers and students interested in the market structure of the Turkish downstream petroleum industry in terms of pricing mechanisms, market efficiencies and comparisons with other countries particularly with the European Union.

The methods and statistical tools in this analysis are mainly used to test for possible asymmetries which signal significant responses of Turkish retail fuel prices to increasing world crude oil prices, but not to decreases. In order to analyze this market inefficiency, econometric modeling involving stationarity and co-integration analysis as well as error correction models have been used.

The results of this empirical analysis could be extended to further research areas and could be used by researchers and Turkish retail market participants in order to get an insight of the Turkish downstream petroleum industry and its pricing mechanism.

1.3 Research motivation

The rationale behind studying the Turkish downstream petroleum industry is to provide a detailed analysis through examining pricing mechanisms and market inefficiencies.

Privatizations and deregulations in petroleum industries have resulted in restructuring of petroleum markets in many countries. Recent studies suggest that pricing asymmetries arising as a result of this restructuring are a cause of market inefficiency which is increasingly being analyzed by researchers in order to clarify this issue. Turkey has also gone through this

restructuring process and the pricing behavior and mechanisms in Turkish retail fuel market has always been discussed in terms of efficiency. The activities of regulatory mechanisms in the downstream petroleum sector is also worth to discuss since the resulting implementation of price ceiling on petroleum products in 2009 has been highly criticized in the sector. This research is expected to contribute to these discussions via providing empirical results of a market inefficiency namely; asymmetrical pricing behavior. On the other hand, it is crucial to analyze the roles of regulatory mechanisms since the refinery is a monopoly and it is the responsibility of these regulatory mechanisms to control and inspect the pricing behavior of the refinery and other players in the downstream market. Thus it is important to analyze and test for possible asymmetries arising in the Turkish downstream petroleum industry, and this paper aims to identify and examine this issue.

What makes the Turkish petroleum market interesting to analyze is the monopoly position of the refiner and the oligopolistic structure of the downstream oil market. It can easily be suspected that lack of competitive market structure will cause market inefficiencies and abnormally high profits for the players in the market. It is also interesting to note that as a sole refiner in Turkey, TUPRAS has legal rights to set prices for their petroleum products up to 3% above the Mediterranean average refinery product prices.

On the other hand proportional taxation that exists in the petroleum market leads Turkish consumers to face one of the highest fuel pump prices in the world (highest in Europe). Taxation consists of value added taxes and special consumption taxes (levied on petroleum products). The fact that around 17% of all tax revenues of Turkish government stem from Petroleum taxes reduces the expectations of possible decreases in special consumption tax levied on petroleum products. Thus the fuel prices in Turkey are expected to remain as one of the highest in the world for the short term. It is also highly criticized that decreases in crude oil prices are not fully reflected to the final pump prices of petroleum products due to increases in taxes in these periods.

All these characteristics of Turkish petroleum markets captured our interest to further analyze possible market inefficiencies via empirical analyses. Furthermore we will also direct the questions of how these market inefficiencies can be corrected and which stakeholders in these analyses have the obligation and power to prevent the existence of possible pricing asymmetries arising from inefficient market structure.

1.4 Research method

The analysis of the Turkish downstream petroleum market is supported by an empirical analysis of weekly data that covers the period 2007 - 2009. The market efficiency is investigated in this work by using statistical and econometric tools such as the Dynamic Ordinary Least Squares (DOLS), the cointegration technique and the Error Correction Model (ECM) in order to examine the fuel price dynamics and the relationship between upstream and downstream prices. As an econometric modeling software, PC Give (Ox Metrics) has been used. The economic theory behind our empirical analysis relies on pricing asymmetry theory involving asymmetrical adjustment of downstream prices to changes in upstream prices.

1.5 Structure

The first part of the thesis presents an overview of Turkish petroleum industry mostly focusing on crude oil supply, demand and refinery sector.

Chapter 3 gives an insight of Turkish downstream petroleum market by analyzing the market structure and the players in the market. Pricing structure and analyses are presented in Chapter 4 by examining the refinery pricing as well as pricing of retailers together with taxation analysis. Regulatory mechanisms and their roles in the market are analyzed in chapter 5. Chapter 6 includes the empirical tools that are used in our analysis in order to test for possible pricing asymmetries followed by empirical analyses and the results of it in chapter 7. Finally, concluding remarks are presented in chapter 8.

2. OVERVIEW OF THE TURKISH PETROLEUM INDUSTRY

2.1 Introduction

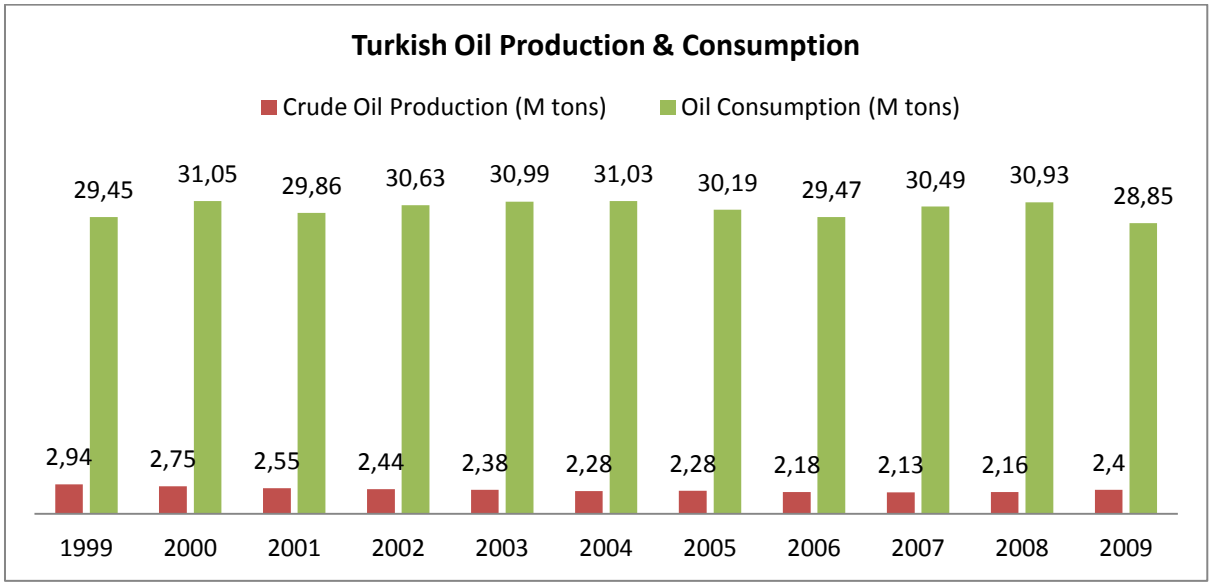
According to BP Statistical Review (2010), 102 million tons (56,6%) of the current petroleum reserves are located in the Middle East, 16,9 million tons (9,4%) located in Africa and 10,2 million tons (5,6%) located in the Russian Federation. Turkey has a strong geopolitical position in the sense that approximately 72% of the petroleum and natural gas reserves are located nearby the country. Thus this strategic position of Turkey is enabling the nation to serve as an energy hub in between continents.

The oldest pipeline that Turkey owns is the Iraq-Turkey pipeline which carries petroleum from Iraq to the western part of Turkey. In 1999, around 305 million barrels of crude oil was flowing through this pipeline, however, as a result of sabotages and problems in Kerkuk the amount of crude oil that is carried through the pipeline decreased to 10,9 million barrels in 2006. In 2009, 165 million barrels (23.3 million tons) of crude oil was transported through the pipeline. Turkey has another crude oil pipeline named Baku-Ceyhan-Tiblisi which has started to operate on 28th of May 2006. The capacity of this pipeline increased to 1 million barrels per day in 2008, and in 2009 the capacity increased to 1.2 million barrels per day (Ministry of Energy and Natural Resources, 2009).

2.2 Oil supply and demand in Turkey

According to the Turkish Ministry of Energy and Natural Resources (2009), at the end of 2009, petroleum reserves in Turkey was equal to 44,3 million tons. Compared to its neighbors such as Iran and Iraq, Turkey has relatively insignificant petroleum production and reserves to be self sufficient to its own industry (see appendix for oil production in Turkey and other OECD countries; Table 10.1).

Figure 2.1: Oil production and consumption in Turkey from 1999 – 2009 in million tons.

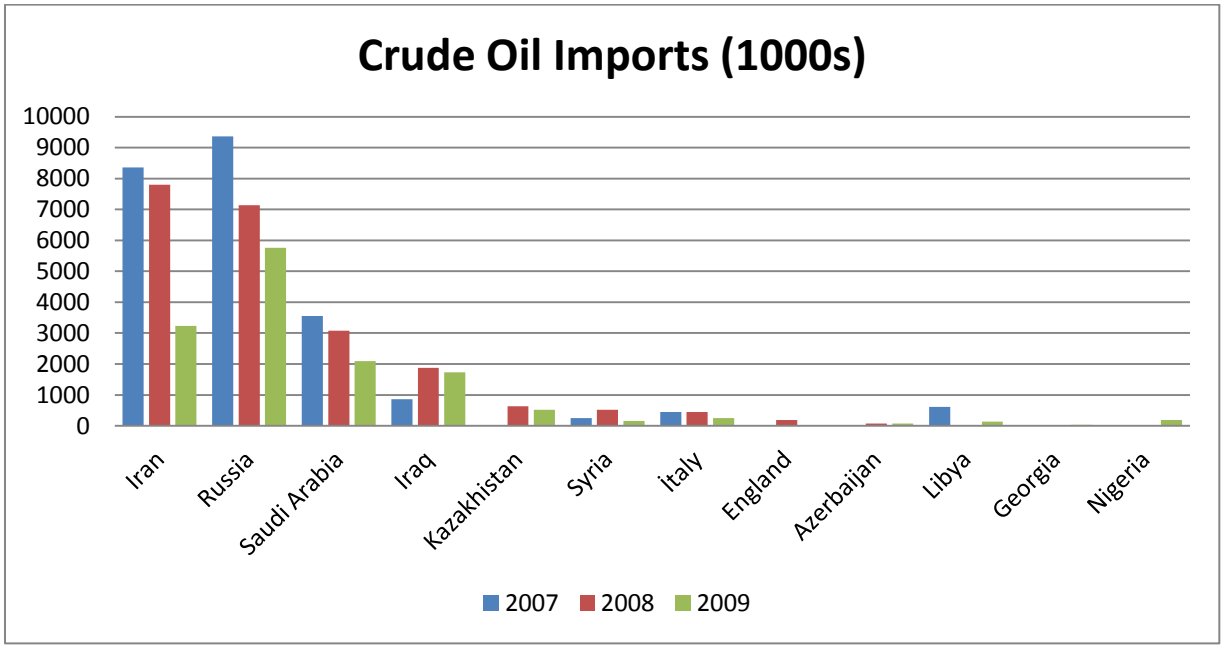


Source: Pigm and BP stat review, 2010.

The figure above shows the yearly production and consumption rates of petroleum in Turkey from 1999 to 2009. Petroleum consumption trend is mainly dependent on global crisis and inland energy demand. The production rates reveal that Turkey is highly dependent on petroleum imports since the production in 2009 which was 28,85 million tons only covered 8% of the total consumption, which was 2,4 million tons. Turkey is an industrializing country and energy consumption is projected to be further increasing in the future. Thus, as a result of small amount of proven reserves in the country, Turkey is expected to be dependent on petroleum imports in the near future, in order to meet its energy demand.

Figure 2.2 shows the amount of petroleum imports (in 1000s) for the years 2007, 2008 and 2009 from different countries. According to the chart the largest petroleum exporting country to Turkey has been Russia for the years 2007 and 2009, whereas Iran took the leading exporting position in 2008. Due to decrease in petroleum demand resulting from the global crisis in 2009, petroleum exports from all countries diminished accordingly. The shares of largest oil exporting countries are highly dependent on international relations between Turkey and these countries as well as political stability and the distance to Turkey.

Figure 2.2: Crude oil imports of Turkey in thousand tons from 2007 to 2009.

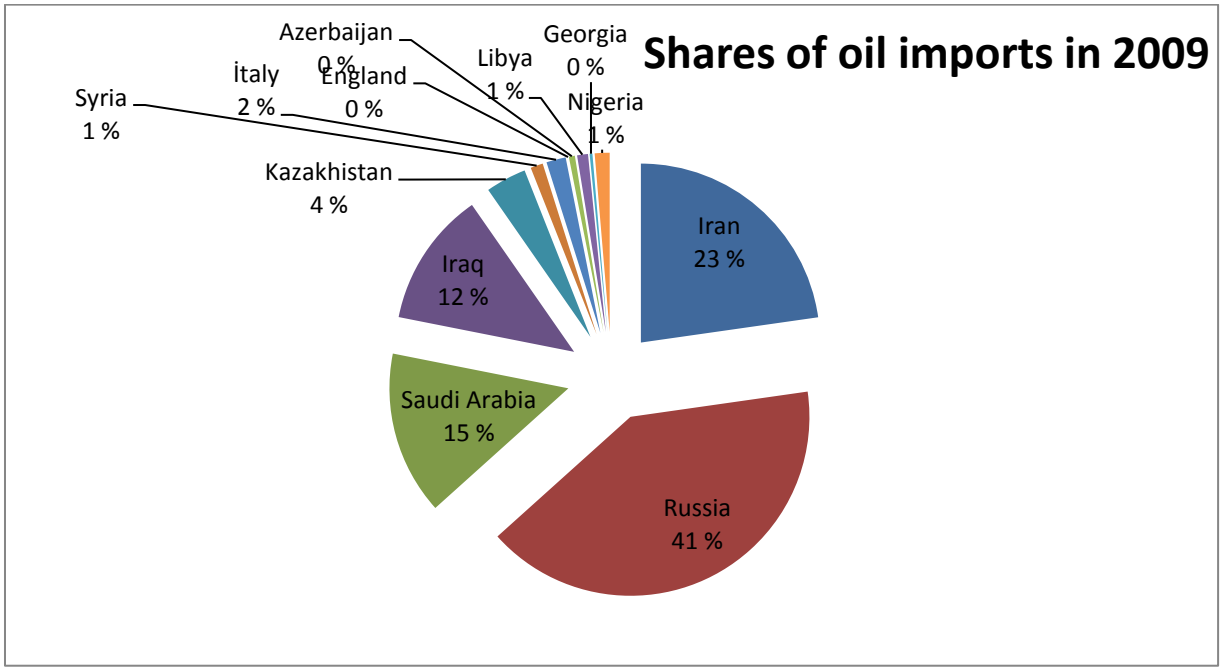


Source: EMRA petroleum sector annual report, 2009.

Figure 2.3 shows the shares of the countries in total amount of petroleum imported by Turkey in 2009. Russia had the largest share in Turkish petroleum imports by 41%, followed by Iran (23%), Saudi Arabia (15%) and Iraq (12%) in 2009. Thus it can be observed that around 91% of the oil imports are coming from Russia and the Middle East. Ceyhan, a small town in the southern part of Turkey closed to Iraq border, is being used as a port for Iraqi oil exports. On the other hand, Turkey has close economics relationships with Russia in terms of energy, tourism and construction sectors. Russia is also one of the most significant natural gas exporters to Turkey.

On the demand side of the petroleum market, the largest oil user sector is transport (49% of the total in 2008), and the growth in this sector has been the strongest from 2000 to 2008 with a rate of 32%. In this sector diesel is so far leading the sales of fuels by almost 59% of all road transport fuels in 2008 (IEA, 2009).

Figure 2.3: The share of oil exporting countries in total oil imports of Turkey in 2009.



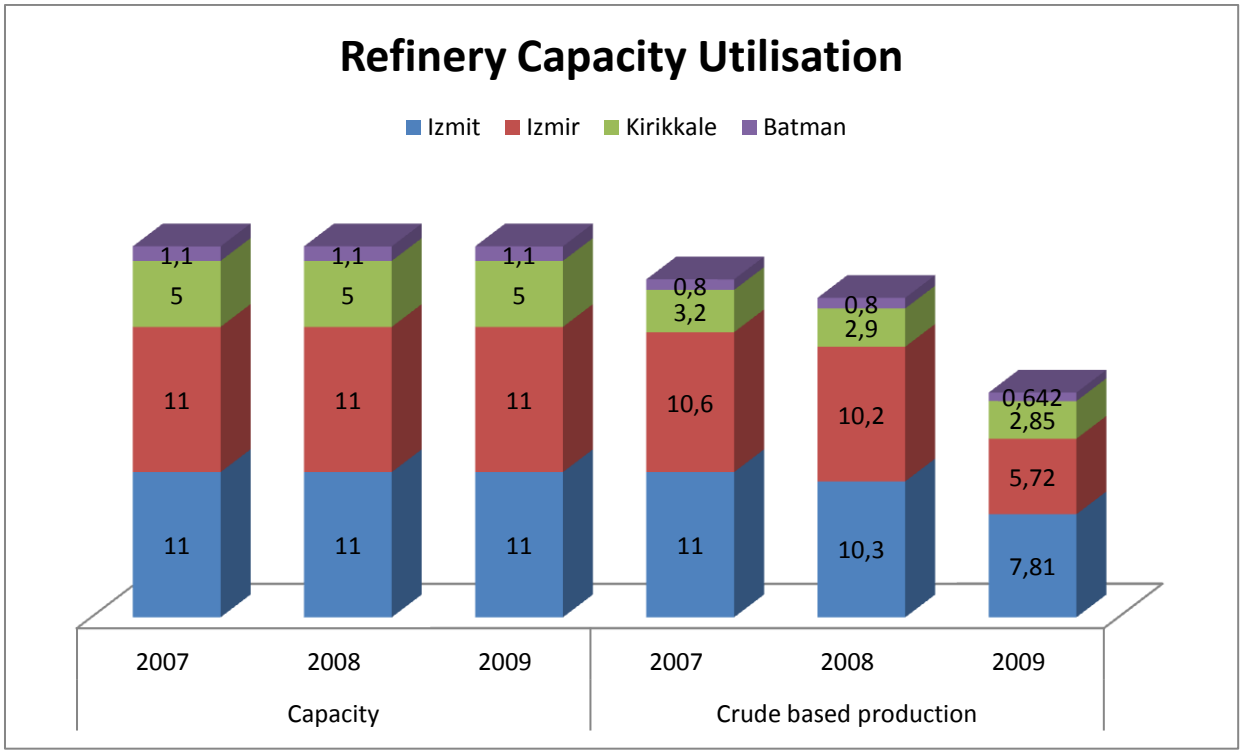
Source: EMRA petroleum sector annual report, 2009.

2.3 Refinery sector

As a country dependent on oil imports to meet the inland demand, Turkey has better figures in refining sectors in terms of meeting its own petroleum products demand. Turkish Petroleum Refineries Corporation (TUPRAS) is the sole refiner, operating four refineries (Izmit, Izmir, Kirikkale and Batman refineries) with a combined capacity of 28,1 million tons (TUPRAS, 2009). Batman Refinery started to operate in 1955 followed by Izmit Refinery in 1961, Izmir Refinery in 1972 and Kirikkale Refinery in 1986. All these refineries belonged to the state and they were incorporated on November 16th 1983 under the name of Turkish Petroleum Refineries Corporation (TUPRAS). TUPRAS had continued its state monopoly position until January 2006 when it was privatized and the state owned monopoly has become privately owned monopoly by a joint conglomerate (Enerji Yatirimlari A.S.). 49% of the company stocks are held by public (is being traded on London Stock Exchange and Istanbul Stock Exchange and the remaining 51% of the stocks is shared by Koc Holding (75%), Aygaz A.S. (20%), Opet Petrolculuk A.S. (3%), Shell Overseas Investment B.V. (1,9%) and the Shell Company of Turkey (0,1%).

Figure 2.4 shows the capacity of the four different refineries of TUPRAS and the crude oil based production in these refineries in 2007, 2008 and 2009. The refineries in Izmit, Izmir, Kirikkale and Batman have crude oil based production capacities of 11, 11, 5 and 1,1 million tons per year respectively. As we can see from the figure, production had steadily declined over this three year period mainly due to the crisis affecting the global economy. The capacity utilization rates for Izmir, Izmit, Kirikkale and Batman has been 100%, 96%, 64% and 73% in 2007; 94%, 93%, 58% and 73% in 2008; 71%, 52%, 57% and 58% in 2009 respectively. The overall total capacity utilization rate for TUPRAS has been %91 %86 and %61 for the years 2007, 2008 and 2009 respectively. It is quite observable from these figures that even when there is no crisis affecting the demand for petroleum products, most of the refineries are not operating with full capacity.

Figure 2.4: Refinery capacities and crude oil based production figures of Izmit, Izmir, Kirikkale and Batman refineries for the years 2007, 2008 and 2009.



Source: TUPRAS annual reports 2007,2008 and 2009.

In order to analyze the monopoly power of TUPRAS in the Turkish downstream petroleum industry, procurement rates should be taken into consideration. Table 2.1 reveals the retailers'

total sales and imports of different fuel types in Turkey. Moreover TUPRAS procurement rate explains how much of these sales consist of fuel types procured from TUPRAS**.** Data show that 66% of total fuel sales of retailers were procured from TUPRAS in 2008. It is also observed that, in 2008, around 89% of gasoline and fuel oil sales were procured from TUPRAS whereas only 58% of diesel sales were procured from TUPRAS. In 2009 TUPRAS procurement rates for gasoline, fuel oil and diesel products were 91%, 94% and 53% respectively. These results show that TUPRAS has a strong monopoly position, especially in gasoline and fuel oil markets in Turkey. As the sole refiner in Turkey, 60-65% of all fuel products sold in Turkey are produced and sold to retailers from TUPRAS, which yields a decisive position in terms of pricing structure in the Turkish downstream petroleum industry.

Table 2.1: TUPRAS procurement rates of licensed retailers in 2008 and 2009.

2008				
	Retail Sales	**Imports of Retailers**	**Retail Sales (TUPRAS products)**	**TUPRAS procurement rate**
Gasoline	2,23	0,33	1,89	**0,85**
Diesel	13,57	5,67	7,91	**0,58**
Fuel Oil	2,35	0,17	2,18	**0,93**
TOTAL	18,16	6,18	11,98	**0,66**
2009				
	Retail Sales	**Imports of Retailers**	**Retail Sales (TUPRAS products)**	**TUPRAS procurement rate**
Gasoline	2,19	0,20	1,98	**0,91**
Diesel	13,71	6,47	7,24	**0,53**
Fuel Oil	1,64	0,10	1,54	**0,94**
TOTAL	17,54	6,77	10,77	**0,61**

Source: EMRA petroleum sector annual report, 2009.

3. MARKET STRUCTURE IN TURKISH DOWNSTREAM PETROLEUM MARKET

3.1 Introduction

The Turkish downstream petroleum industry demonstrates the characteristics of an oligopolistic market structure in the sense that, in 2009, the market consisted of 43 active retailers while around 80% of the market share is divided among five big players namely; Petrol Ofisi, Shell, BP, Opet and Total.

According to the Competition Authority in Turkey, there exist structural barriers to competition in the downstream market mainly due to lack of price competition among the distribution companies (IEA, 2009). In terms of ownership and right of use of fuel stations in the market, the owners of retail fuel stations in Turkey had been signing usufruct agreements with retail distributers lasting up to 20 years. The Energy Market Regulation Authority (EMRA) intends to increase the competition in the market further through enacting a usufruct law in limiting the usufruct contracts of fuel stations to 5 years. Thus, all the usufruct agreements lasting more than 5 years signed before 18.09.2010 are ending on 28th of May 2010 and the new usufruct agreements are limited to 5 years for the following years (EMRA, 2009). This decision by the supervisory board is aiming to increase the competition in the market, further disturbing the oligopolistic structure.

3.2 Top five players in the downstream market in terms of sales

Petrol Ofisi: Petrol Ofisi had been formed in 1941 as a public company in order to meet the demand of public and private corporations as well as the end users. The company had been privatized in 2000 and in terms of retail network; Petrol Ofisi operates 2500 fuel stations in Turkey ranking 1st in terms of retail network size. In 2010, OMV group acquired 96,98% of Petrol Ofisi's shares. By the end of 2009, Petrol Ofisi owned licensed storage capacity of 986405 m^3 which constitutes 23,4% of total licensed storage capacity in Turkey (EMRA, 2009).

Shell & Turcas: Shell stepped into the Turkish market in 1923 when the republic was founded. In 2006, Shell Company of Turkey was restructured and had been engaged in a joint venture with Turcas Petrol. As a result of this joint venture, retail and corporate sales segments of petroleum products had been reformed with 70% of Shell and 30% of Turcas Petrol shares. Turkey is categorized as one of the six strategic markets for Shell in downstream segment with more than 1200 fuel stations, ranking third among other Shell affiliates worldwide in terms of the size of retail network. By the end of 2009, Shell possessed licensed storage capacity of 220114 m3 that constitutes 5,2% of total licensed storage capacity in Turkey (EMRA, 2009).

BP: BP's operations in Turkey first started in 1912 as a result of company strategy via expanding emerging markets, especially after the discovery of petroleum in Iran. BP had played an active role in upstream and mid stream market as well; via 17% ownership of Mersin Refinery (until 1978) and exploration activities in Turkey together with Turkish state owned exploration and production company TPAO. However, the company focuses mainly on downstream market currently and operates 630 fuel stations together with 200 LPG gas stations in downstream market. By the end of 2009, BP owned licensed storage capacity of only 7535 m^3. Additionally, BP owns a storage point for imported petroleum products in Bursa with a storage capacity of 26381 m^3 (EMRA, 2009).

Opet: The Company was established in 1982 by an entrepreneur who first operated locally in Mersin area and then moved to Istanbul in 1992. Opet has been growing successfully since the foundation of the company and 50% of which was owned by Koc Company by the end of 2002. In terms of vertical integration, this ownership created competitive advantage for OPET especially after privatization of TUPRAS in 2006 (Koc Holding acquired 95% of corporate shares of TUPRAS and 3% of the corporate shares is owned by Opet). In terms of retail network size, Opet is the 3rd largest fuel retailer in Turkey with more than 1200 fuel stations (including Sunpet). By the end of 2009, Opet possessed licensed storage capacity of 547000 m^3 constituting 13% of the licensed storage capacity in Turkey (EMRA, 2009).

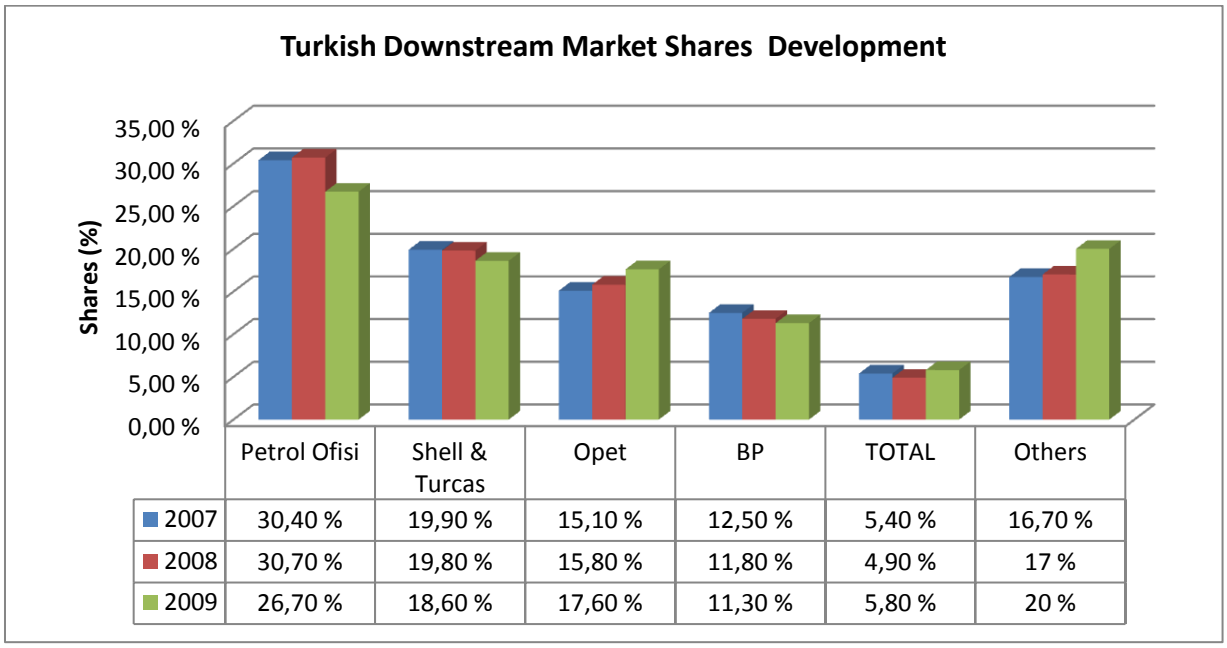
Total: Total and Elf companies had been operating in Turkey since 1992 and as a result of global merger between these companies Total Petroleum Turkey had been established in 2002. Total operates around 450 fuel stations in Turkey. By the end of 2009, Total owned licensed storage capacity of 279275 m^3 constituting 6,6% of the total storage capacity in Turkey (EMRA, 2009).

3.3 Market shares of top five players in the downstream market

As explained in the previous sections, according to 2009 figures, 80% of the market share in the downstream market is distributed between five players namely; Petrol Ofisi, Shell, BP, Opet and Total whereas 43 players are actively operating in the market.

Three global players in the world petroleum market with vertically integrated organization structures, namely Royal Dutch Shell (70% ownership of Shell&Turcas), BP and Total, retain around 35% of the market share in the Turkish downstream petroleum industry.

Figure 3.1: Market share development in Turkish downstream petroleum market from 2007 to 2009.



	Petrol Ofisi	Shell & Turcas	Opet	BP	TOTAL	Others
2007	30,40 %	19,90 %	15,10 %	12,50 %	5,40 %	16,70 %
2008	30,70 %	19,80 %	15,80 %	11,80 %	4,90 %	17 %
2009	26,70 %	18,60 %	17,60 %	11,30 %	5,80 %	20 %

Source: EMRA petroleum sector annual reports, 2007, 2008 and 2009.

In terms of market shares, Petrol Ofisi is the market leader with 26,7% market share in 2009; however it has been losing its share against other competitors since 2007. Market shares of Shell & Turcas had been fairly stable from 2007 to 2009 moving around 19% that positions the company second in the market in terms of market shares. We observe an increasing trend

for OPET from 2007 to 2009 in terms of market shares, as a result of completive advantage realization through vertical integration with TUPRAS and expansion strategy of the company. Opet's market share increased from 15% to 18% from 2007 to 2009. BP is experiencing a loss in its market share from almost 13% in 2007 to 11% in 2009 whereas TOTAL's market share had been moving around 5% during these 3 years. It is also observed that the shares of other relatively small sized competitors had been increasing from 17% to 20% from 2007 to 2009 indicating positive signs in terms of a more competitive market.

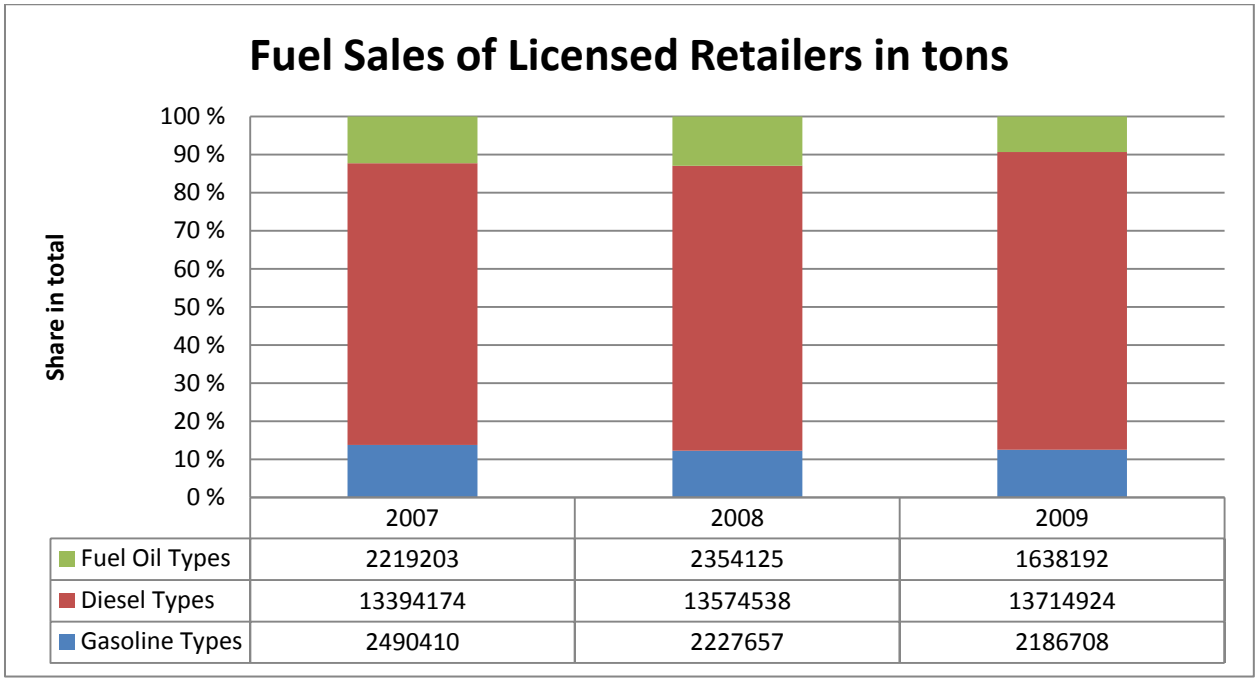
3.4 Downstream sales figures of different fuel types

In order to examine the consumption characteristics and patterns in the Turkish downstream petroleum industry, retail sales of the licensed players according to different fuel types will be examined in this section.

Figure 3.2 reveals the total sales of fuel oil, diesel and gasoline types of fuels together with their shares in total sales of petroleum products in 2007, 2008 and 2009.

According to EMRA (2009), around 75% of the fuel sales realized by licensed retailers consisted of diesel types of fuel. Figure 3.2 indicates that the sale of diesel types had been increasing from 2007 to 2009 whereas the sale of gasoline types was decreasing in the same period. Diesel types include industrial diesel used for industrial purposes and euro diesel used as fuel with low sulphur rates. On the other hand, the share of fuel oil types (mainly used for industrial purposes) decreased from 2007 to 2009, due to global crisis affected the industries utilizing this petroleum product in their production processes.

Figure 3.2: Sales of different petroleum products of licensed retailers in Turkey in tons for the years 2007, 2008 and 2009.



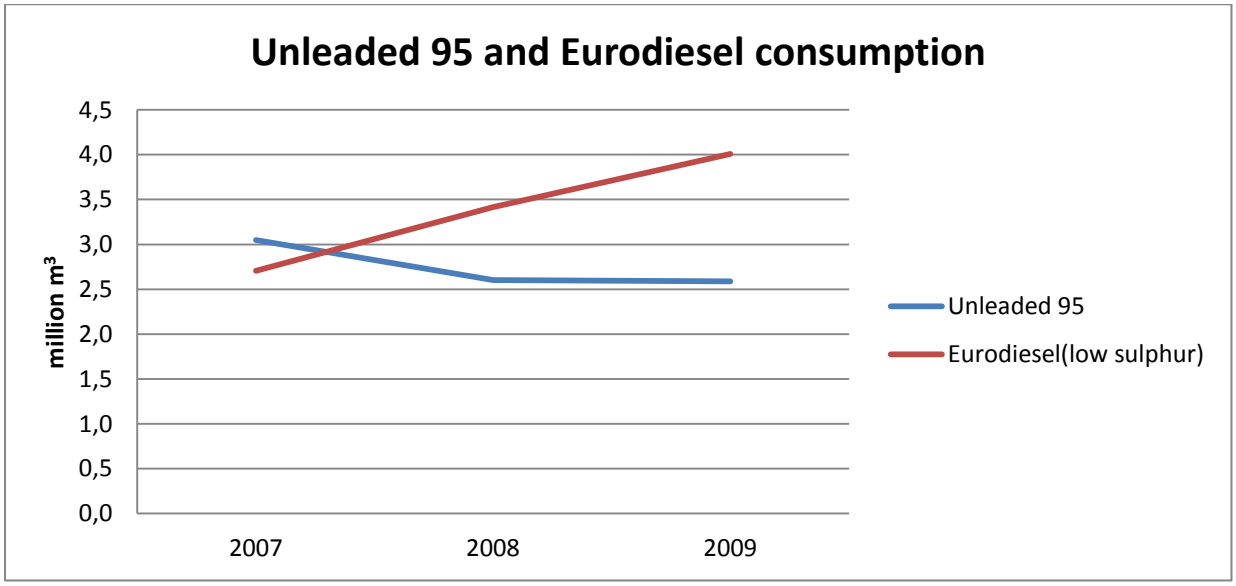
	2007	2008	2009
Fuel Oil Types	2219203	2354125	1638192
Diesel Types	13394174	13574538	13714924
Gasoline Types	2490410	2227657	2186708

Source: EMRA petroleum sector annual report, 2009.

Notes: Gasoline types include; unleaded gasoline 95 and 98 octane plus leaded gasoline 95 octane. Diesel Types include; euro diesel and industrial diesel. Fuel Oil Types include; Fuel oil 3,4,5 and 6

The consumption trends among 95 octane unleaded gasoline and euro diesel (low sulphur) are represented in figure 3.3. The trends and consumption figures in the chart indicate that euro diesel consumption increased from 2007 to 2009 year by year whereas 95 octane unleaded gasoline consumption performed a decreasing trend over these years. Due to increasing prices of fuel over these periods (especially from 2007 to 2008), euro diesel consumption performs an increasing trend mainly because of more fuel saving technology of diesel engines and lower prices of diesel compared to gasoline products.

Figure 3.3: Consumption trends of 95 octane unleaded gasoline and Euro diesel (low sulphur diesel) in million m^3 from 2007 to 2009.



Source: EMRA petroleum sector annual report, 2009.

4. PRICING ANALYSIS IN THE DOWNSTREAM MARKET

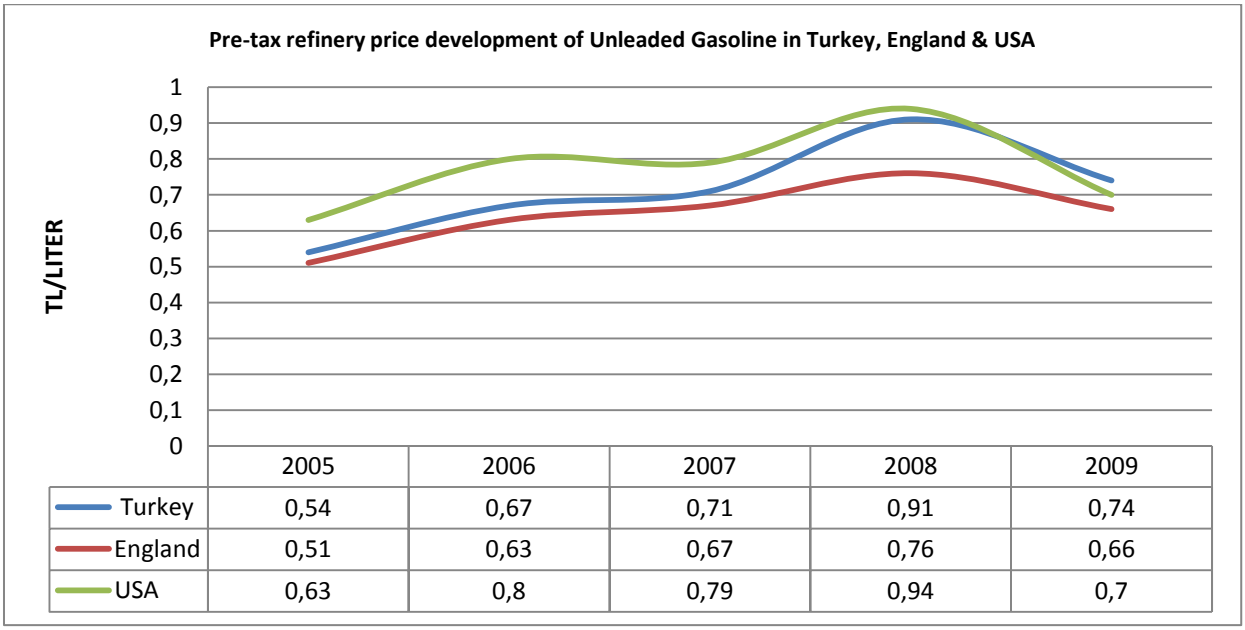
4.1 Introduction

In this section, we will analyze the pricing behavior in the Turkish downstream petroleum industry in detail and compare it with the price developments in other countries. What comprises the pump prices of fuels are refinery prices, retailer and distributor margins and taxes. We will analyze the price developments in each one of these phases and comment on their contribution to the end user price.

4.2 Refinery pricing

TUPRAS, as the sole refinery in Turkey, has strong power in terms of pricing petroleum products of its own.

Figure 4.1: Pre-tax refinery prices in Turkey, England and USA in Turkish liras per liter from 2005 to 2009.



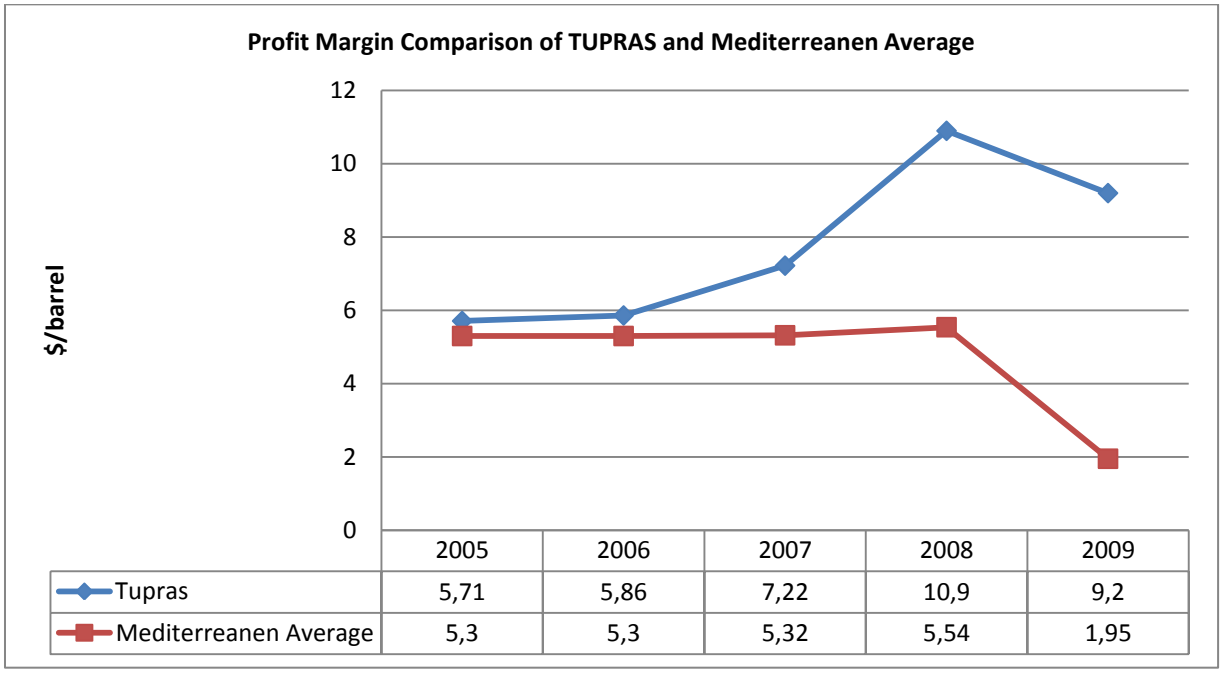
	2005	2006	2007	2008	2009
Turkey	0,54	0,67	0,71	0,91	0,74
England	0,51	0,63	0,67	0,76	0,66
USA	0,63	0,8	0,79	0,94	0,7

Source: Gokdemir, 2010.

On the other hand, as we've discussed earlier in section 2, around 90% of the crude oil demand of Turkey is met by imports. Taking this into consideration, we could expect that refinery prices should be in line with fluctuations in the world market.

As inferred from Figure 4.1, pre-tax refinery prices of unleaded gasoline in Turkey have been almost fairly in line with the prices in USA and England. The refinery prices of unleaded gasoline prices were lower than the prices in USA and higher than the refinery prices in England until 2009. In 2009, the decline in pre-tax refinery prices of unleaded gasoline in Turkey was not as strong as the decline in other countries. It is observed that the pre-tax refinery price is realized as 0,74 TL/Liter in 2009; 0,04 TL/Liter higher than the price observed in USA.

Figure 4.2: Profit margin figures of Mediterranean average and TUPRAS in dollars per barrel from 2005 to 2009.



	2005	2006	2007	2008	2009
Tupras	5,71	5,86	7,22	10,9	9,2
Mediterreanen Average	5,3	5,3	5,32	5,54	1,95

Source: Gokdemir, 2010.

In order to examine the characteristics or the roots of asymmetry if there exists one in the downstream petroleum market, we could also take into account the effects that might result from refining sector and profit margins. We could observe the development of profit margins

of TUPRAS starting from 2005 to 2009 in comparison with the Mediterranean average margin from figure 4.2. The profit margin of TUPRAS for the years 2005 and 2006 follow a similar pattern as the Mediterranean average margin. However, TUPRAS realized a steep margin increase for the years 2007 and 2008 as opposed to negligibly small average margin increase in Mediterranean refineries. This figure and margin movements imply that TUPRAS has increased its profit margin after the refinery was privatized in the beginning of 2006 further above the average Mediterranean average profit margin. This margin increase is noteworthy and will be discussed in the conclusions part while discussing the possible asymmetries arising in the Turkish downstream petroleum industry.

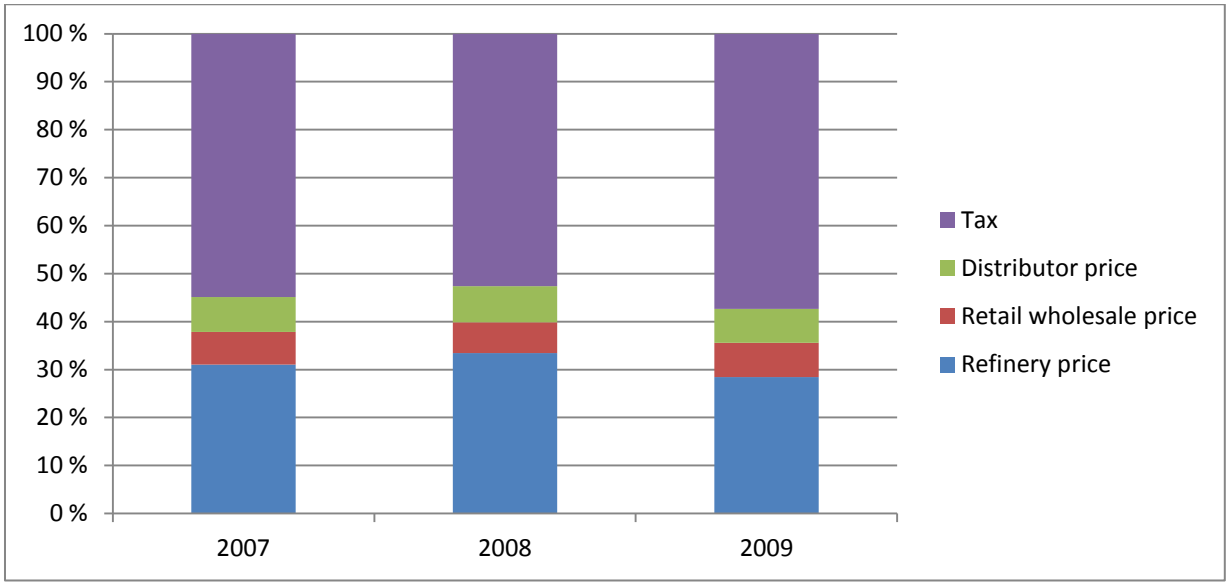
4.3 Retailer and distributor pricing

On the other hand, pump price of fuels also consists of different components other than refinery price. Refineries sell their products to retailers with refinery exit price and then retail companies add a margin on the refinery exit prices which constitutes the retail price of these petroleum products. Eventually, retail companies sell these petroleum products to their licensed distributors and the distributors also add a margin to this price. Additionally, taxes are levied on the sum of refinery exit price, retail margin and distributor margin contributing to the final pump price.

Figure 4.3 indicates that taxes constituted around 55% of the pump price of diesel in Turkey for the years 2007, 2008 and 2009. It is also noteworthy that distributor and retail margins both constitute around 7% of the pump price. On the other hand, around 30% of the pump price of diesel in Turkey reflects the crude oil prices plus refinery margin.

As we can observe from the figure, retail wholesale margin and distributor margin remained almost stable for this three year period, whereas the shares of refinery price and tax on the final pump price of diesel in Turkey has been changing over this three years period.

Figure 4.3: Shares of tax, distributor price, retail whole sale price and refinery price on diesel pump prices in Turkey for the first day of 2007, 2008 and 2009.



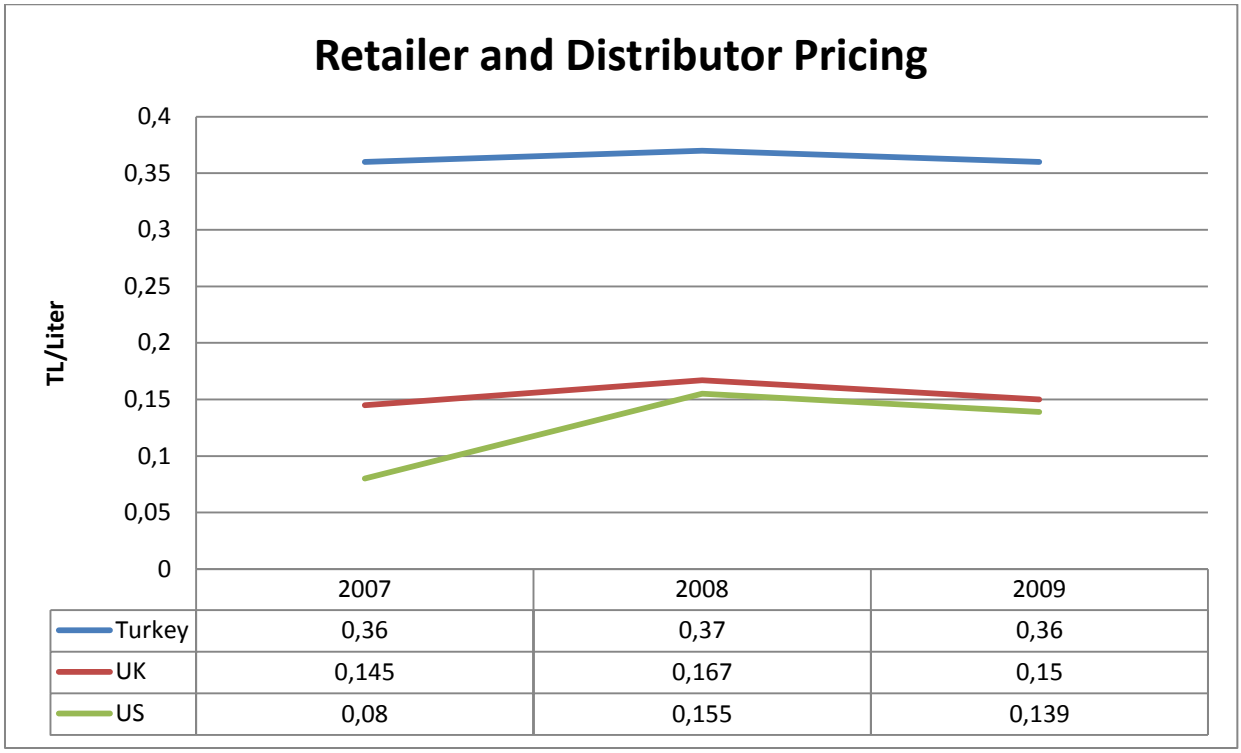
Source: EMRA petroleum sector annual reports, 2007, 2008 and 2009.

For further discussions of results of our empirical analysis in the following chapters, it is important to note that the share of tax on diesel pump prices increased for the year 2009 compared to the share in 2008. This increase in the share of tax is observed in the period where the crude oil prices were declining due to the recession and during this decrease, government captured a higher share of final pump price by simply levying more tax on petroleum products.

On the other hand, it is also crucial to compare the retailer and distributor pricing and their shares in the final pump price of diesel without tax with other countries. Figure 4.4 represents the retailer and distributer pricing of Turkey, UK and the US in Turkish Liras per liter. It is observed from the figure that retail and distributor prices are significantly higher than the prices in UK and the US. On average, distributer and retailer prices are 2,5 times higher than the prices in UK and the US. Gokdemir (2010) suggested in his paper that the reason behind this difference in retail and distributor prices is mainly due to the differences in costs in these countries. In contrast to many other countries, the fuel stations in Turkey are not self service stations and the fuel stations in Turkey employ pumpers, car washers etc. increasing the operating costs. On the other hand, the locations of storage facilities and the refineries in

different countries also affect the costs of retailers and distributers causing differences in retailer and distributor prices.

Figure 4.4: Comparison of retailer and distributor pricing together on the pump price of diesel without tax in Turkish Liras per liter between Turkey, UK and the US.



	2007	2008	2009
Turkey	0,36	0,37	0,36
UK	0,145	0,167	0,15
US	0,08	0,155	0,139

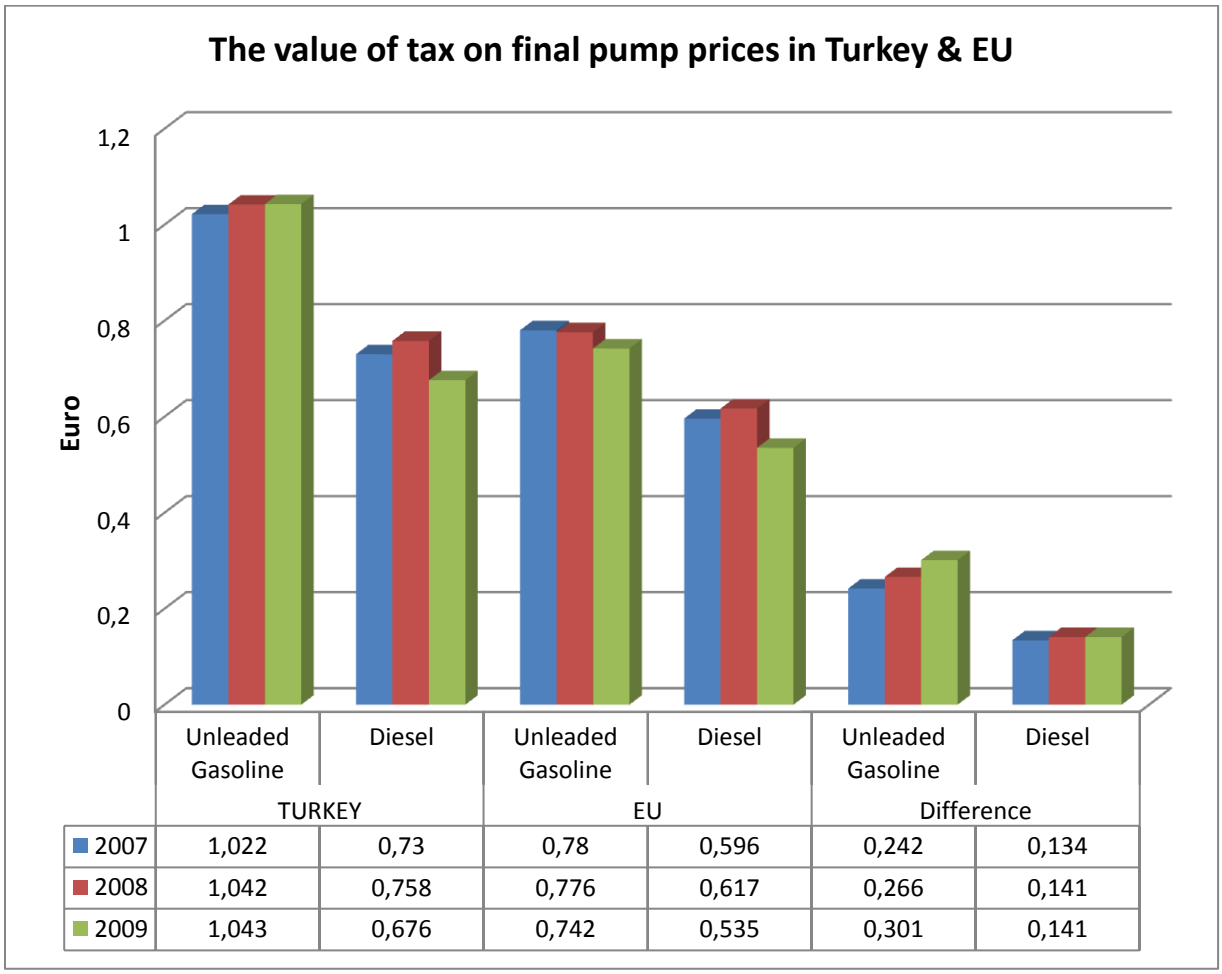
Source: Gokdemir, 2010

However it is also important to note from Figure 4.4 that retailer and distributor prices together had been mostly resilient to the crude oil price fluctuations from 2007 to 2009, whereas UK and the US prices fluctuated more in line with crude oil price changes in the same period. On the other hand, it is obvious that the significant decrease in crude oil prices from 2008 to 2009 was not reflected notably to the retailer and distributor pricing in Turkey.

4.4 Taxes

It is a fact that the pump prices of fuels in Turkey are the highest compared with the other European countries and Turkish consumers are paying around 60% of the final pump price as taxes to the government (PETDER, 2009).

Figure 4.5: The value of tax in Euros per liter on final pump prices of fuel in Turkey and EU from 2007 to 2009.



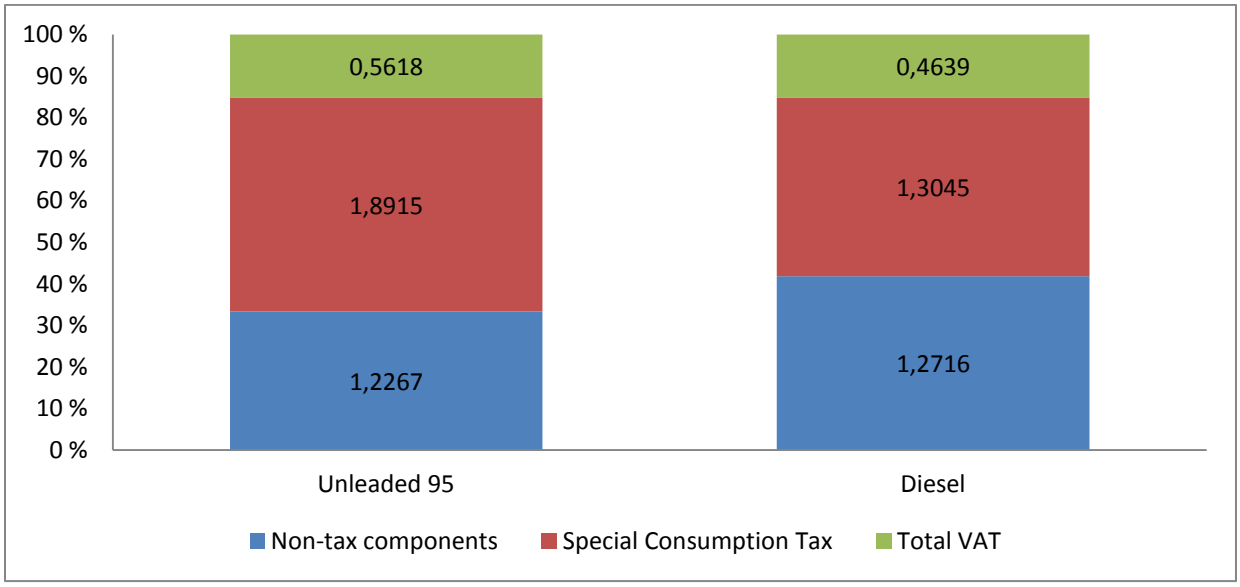
	TURKEY		EU		Difference	
	Unleaded Gasoline	Diesel	Unleaded Gasoline	Diesel	Unleaded Gasoline	Diesel
2007	1,022	0,73	0,78	0,596	0,242	0,134
2008	1,042	0,758	0,776	0,617	0,266	0,141
2009	1,043	0,676	0,742	0,535	0,301	0,141

Source: Gokdemir, 2010.

When we look at the taxes levied on fuels in EU and compare them with the figures in Turkey, in 2009 we observe that the taxes in Turkey account for 1,043 Euros per liter for unleaded gasoline and 0,676 Euros per liter for diesel, whereas in EU taxes on pump prices of unleaded gasoline are 0,742 Euros per liter and the taxes on diesel are 0,535 Euros per liter. These figures imply that the tax revenue stemming from a liter of unleaded gasoline and diesel consumption in Turkey is, respectively, 41% and 26% higher than the tax revenue in EU.

It is also important to point out the significance of tax revenues stemming from petroleum products in terms of share of total tax income in Turkey. Taxes levied on fuels in Turkey could be categorized in two; Special consumption tax and value added tax (18%). Addition of special consumption tax to the normal value added tax levied on all petroleum products sold in the market constitutes the most significant income source for the Turkish government in terms of tax income.

Figure 4.6: Contribution of special consumption tax and value added tax to the final pump prices of 95 octane unleaded gasoline and diesel in Turkey.



Source: EMRA petroleum sector annual report, 2009.

Unlike value added tax, special consumption tax is an excise tax levied on petroleum products. It was introduced in 2002 with special consumption tax law and has been subject to many changes until now. When it was first introduced in 2002, the council of ministers set special consumption tax to 0,739 TL/liter for 95 octane unleaded gasoline and 0,516 TL/liter for Diesel. The last change that occurred in special consumption tax was at the end of 2009 and the special consumption tax on 95 octane unleaded gasoline and diesel increased to 1,8915 TL/liter 1,3045 TL/liter respectively (Gokdemir, 2010). As we can observe from these figures, special consumption tax on gasoline and diesel has increased around 155%, since the day it is first introduced in 2002.

As we can observe from Figure 4.5, by the end of 2009, 66% of the pump price of 95 octane unleaded gasoline and 58% of the pump price of diesel is constituted of taxes. On the other hand special consumption tax constitutes 51% of the pump price of 95 octane gasoline and 43% of the pump price of diesel, whereas value added tax constitutes 15% of the pump price of each petroleum product.

Thus it can be stated that taxes constitute the most significant portion of the final pump prices in Turkey. Moreover, the introduction of special consumption tax has provided a significant tax source for the government and special tax consumption tax has increased many times since the day it is introduced.

Table 4.1: Total government tax revenue and fuel taxes in Turkey in billion Turkish Liras from 2007 to 2009.

Years	Total Taxes on Fuel	Government Tax Income	Share of Fuel Tax on Total government tax income
	VAT + Special Consumption Tax		
2007	26,0	152,8	17,0%
2008	28,5	168,1	16,9%
2009	29,5	172,4	17,1%

Source: Gokdemir, 2010.

The above table reveals the development of tax revenue over the years 2007, 2008 and 2009 as well as the development of share of fuel tax over total tax revenue of Turkish government.

As it may be observed, tax revenues stemming from fuel consumption, increased over the years and the share of fuel tax revenue over the total tax revenue of government also slightly increased from 2007 to 2009. It is important to note that in 2009, due to global crisis, fuel prices were declining and there had been a notable decrease in fuel consumption in Turkey. Nevertheless, tax revenue stemming from fuel consumption increased in 2009, due to increases in special consumption tax that is levied on petroleum products, especially in the period of price ceiling regulation.

5. REGULATION IN TURKISH PETROLUEM INDUSTRY

5.1 Introduction

The Turkish downstream petroleum industry is being regulated by different regulatory mechanisms in order to ensure a well functioning market. The preparation and implementation of energy policies, plans and programs are under the control of The Ministry of Energy and Natural Resources. This process is coordinated with the help of its affiliated institutions such as the Energy Market Regulation Authority and the Competition Authority together with other public and private entities (IEA, 2009).

The Turkish downstream petroleum market is being regulated under the law 5015 which became effective in 2003. This law enabled the market to further liberalize by abolishing the automatic pricing mechanism and allowing the players to set prices via referencing the international prices (Gokdemir, 2010). The aforementioned automatic pricing mechanism obligated the state owned refineries to set their prices automatically according to the fluctuations in the crude oil markets via a set formula. As stated in the new law, it is aimed to enhance the competition in the market and reorganize the sector in order to comply with international norms and standards. This law has also enabled the certified corporations to purchase petroleum products freely. In terms of vertical integration, the law allows the owners of the refineries to sell their products through their own retail stations; however the refinery is also obliged to provide same market conditions (pricing, quantity etc.) to the other retailers as well. In terms of refinery pricing, the law enables the refinery to set its petroleum product prices above 3% of the CIF Mediterranean prices.

Retailers are also bounded with this law in terms of enhancing the competition among them. The petroleum law 5015 states that the market share of a single retailer can not exceed 45% of the total market. On the other hand, the ownership of fuel stations is also regulated under this law in order to increase the competition in the sector. The law states that the sales of retailer owned stations can not exceed 15% of the total market share of the retailer.

As we stated previously, the Ministry of Energy and Natural Resources is responsible for implementation of energy policies, plans and laws. On the other hand, assurance and control

of these policies and laws are being held by affiliated institutions acting as supporting mechanisms. The main stakeholders in our regulation analysis of Turkish downstream oil industry are the Energy Market Regulation Authority and the Competition Authority. In the following sections we will give more insight to their functioning and impacts on the industry.

5.2 The Competition Authority

The Competition Authority was established in 1997 in order to secure competitive conditions in markets with the aim of increasing social welfare via ensuring efficient resource allocation.

As stated in the Competition Authority's official website (2010), the goal of the institution is to facilitate and secure competition in all markets. Responsibilities of this independent institution are:

- to penalize undertakings which distort or prevent competition in the market, through examination and investigation processes subject to detailed regulation,
- to grant exemption and to prepare secondary regulations for agreements which are in conflict with competition rules but are beneficial for the economy and the consumers,
- to prevent monopolization within the market by examining mergers, acquisitions and joint-ventures over a certain threshold,
- to examine the transfer of public undertakings to the private sector in the privatization stages, and through privatization, to reduce the effects of the state on the economy while preventing monopolization in the areas the public sector exits,
- to ensure the dominance of competitive conditions within the markets by expressing opinions on various acts and regulations which would negatively affect or restrict competition in the markets to government institutions and organizations concerned.

In 2008, EMRA requested the Competition Authority to publish a fuel sector report in order to examine the price movements in the downstream market. The results of this inspection suggest that there is evidence of pricing asymmetries in Turkish downstream market due to slower adjustments of fuel prices to decreases in crude oil prices both at refinery and retail price levels. The report also suggests that the refinery (TUPRAS) has gained further market

power and a strong price setting position after the privatization. According to this sector report, the Competition Authority concluded that TUPRAS's petroleum product prices are being observed above the referenced CIF Mediterranean average prices, however still in the range of 3% as stated in the law (Gunduz et al., 2008).

As a result of this report, the Competition Authority concluded that the refinery (TUPRAS) is pricing its products in line with the related petroleum law; however there is no concluding remark whether the refinery is asymmetrically adjusting its product prices to the changes in crude oil prices. Thus the report suggested no sanction to the refinery as it follows the allowed pricing strategy in the law. The report also concluded about the retail sector that there is lack of competition and the retail and distributor prices are above the European average. It is also noted that downward movements of crude oil prices are not as much reflected to the retail and distributor prices as upward movements. It is included in the report that the costs in Turkey might reflect the high downstream and retail prices, however, due to the structural problems existing in the retail market, the Competition Authority suggested EMRA to use it regulatory power.

5.3 The Energy Market Regulation Authority

The Energy Market Regulation Authority (EMRA) was established in 2001 via the Electricity Market Law as an independent regulatory authority for the utility sector. After the enactment of Petroleum law 5015, EMRA was given responsibility to regulate the petroleum sector as well. The decision making body consist of a board which is composed of nine members, including a chairperson and a vice chairperson (IEA, 2009). EMRA is responsible to secure a well operating efficient market through inspections and regulations.

Before the enactment of petroleum law 5015, the upstream and downstream sectors were both regulated via the previous law and the former law was more concerned with the upstream sector, paying less consideration to the downstream sector. However, the enactment of the new law assigned EMRA as independent regulatory authority and enabled the downstream market to be regulated more in detail allowing a more liberal market.

EMRA is also responsible to ensure competitive pricing policies of the stakeholders in the downstream petroleum market. One of the most important responsibilities of this institution is to inspect whether the prices of the refinery products and pump prices are in line with the fluctuations in crude oil prices. In case of unexpected price movements in the market allowing the players to retain abnormal profits, it is EMRA's responsibility to conduct inspections regarding the situation and implement sanctions to the responsible stakeholders.

In 2008, due to public opinion towards high fuel prices and asymmetric price adjustments to decreases in crude oil prices, EMRA authorized the Competition Authority to inspect the market and to submit a detailed report regarding the situation. The Competition Authority submitted the report in three months and as stated in this report, it is noted that there is lack of competition in the retail market and the players do not follow the global price movements. In terms of refinery pricing, it is indicated that the refinery (TUPRAS) followed the 3% mark-up rule in this period, however some evidence found that the refinery pricing also exhibited deviations from the world prices within this 3% mark-up pricing (Gunduz et al. 2008). Conclusively, the petroleum law allows the refinery to set the prices within the 3% corridor of the CIF Mediterranean average prices, thus EMRA concluded that sanctions should be implemented to the retailers and distributors in order to overcome this inefficiency of the market.

In 2009, EMRA imposed a ceiling price for the pump price of the petroleum products starting from the end of June until the end of August. In this period of two months, the ceiling prices of the petroleum products are set daily with a formula including CIF Mediterranean average price. The period ended in August 2009 and as a result, the distributor and retailer margins decreased, however in the same period special consumption tax was increased. Thus the resulting decrease in distributor and retailer margin had been transferred to the government as tax revenue.

6. ECONOMETRIC TOOLS TO TEST THE PRICING ASYMMETRY

The empirical study of pricing asymmetry analysis of the Turkish downstream petroleum industry requires the use of advanced econometric tools and concepts that we will be defined in this chapter. Furthermore, we will explain the need and the goals of using such methods.

The market efficiency will be investigated empirically by using ADF tests on fuel prices and Brent price of crude oil as well as using cointegration analysis and asymmetric ECM theory. The rationale behind asymmetry analysis is to test for a market inefficiency resulting from a slower adjustment of downstream prices to decreases in upstream prices whereas the increases in upstream prices are quickly transmitted to downstream prices. As we will discuss in further sections, the tools of econometrics will be utilized first to check for stationarity of the data, followed by cointegration analysis and finally concluded with estimating the asymmetric error correction model in order to test for possible asymmetries.

Empirical analysis will be followed by a concluding part where we will discuss the results of our analysis. Further discussion will be based on possible roots of asymmetries if there exist any in the Turkish downstream petroleum industry.

The phenomenon of asymmetric transmission of decreases in upstream prices to downstream prices is widely believed by consumers. Increasing fluctuations of crude oil prices starting from the second half of the twenty first century due to recessions, wars and resulting petroleum supply crisis affected the price of fuel products as well. However, these fluctuations also attracted the stakeholders to obtain possible gains resulting in asymmetries of price adjustments in the petroleum industries.

6.1 Literature review

The literature on pricing asymmetry analysis of crude oil and fuel prices is wide in terms of country specific analysis using monthly, weekly and daily data. Dynamic regression models are applied to test for possible asymmetries arising from different reasons.

Bacon (1991) is considered to be the first in literature to analyze the problem of asymmetrical responses of gasoline products to decreases in upstream prices. In his analysis, the focus was on UK gasoline market, and weekly data was used in order to analyze the possible asymmetries for the period 1982-1989. Slower adjustment of retail prices to decreases in crude oil prices in UK is found in his paper for the period inspected which indicated an existing asymmetry.

Manning (1991) has also analyzed the UK gasoline market in order to test for possible asymmetries. He utilized monthly data instead of weekly data and extended the period analyzed to 1973-1988. The results of the dynamic ECM suggested that there existed weak and non-persistent asymmetry for the periods investigated.

The possible asymmetric adjustment of price changes in Germany is analyzed by Kirchgässner and Kübler (1992) for the period 1972-1989. The specified period is analyzed by using monthly data and investigating two sub-periods; namely before and after 1980. The results of this analysis reveal short-run asymmetries for the first sub period (before 1980). However, the data for second period do not suggest asymmetries in prices. It is also argued that the reductions in petroleum prices are transferred faster than the increases due to the effects of politicians and trade unions.

Dufy-Deno (1996) analyzed the US market by simply investigating the price adjustments between wholesale and retail gasoline prices without tax. Weekly data is used in this analysis to test for the period 1989-1993. The results reveal that there exist strong asymmetries, implying slower adjustment of retail prices to decreases in upstream prices than to increases.

The US gasoline market had also been investigated by Borenstein et al. (1997) for the periods 1986-1992 by using weekly data. The results of this analysis support the short run asymmetries arising from quicker retail price reaction to increases than to decreases in crude oil prices.

Balke et al. (1998) brought a different perspective to asymmetry analysis by analyzing the effect of model specification in these empirical investigations. It is suggested by the author's analysis that the results of asymmetry analysis are sensitive to model selection. However the results support the existence of asymmetry in different confidence levels. Distributed lag models suggest weak asymmetry whereas ECM indicates persistent asymmetry for the period chosen.

The analysis of Bacon (1991) on UK gasoline had also gained attention by Reilly and Witt (1998). The authors used monthly data for the period 1982-1995 in order to analyze the possible effects of exchange rate (pound and dollar) on asymmetry analysis. The results still suggested short-run asymmetries for the period rejecting the hypothesis of exchange rate effects on the asymmetry found in the specified period.

Similar analysis of asymmetric price relationships in gasoline markets had been conducted by Godby et al. (2000) focusing on the Canadian market. Weekly data for thirteen different cities are used in this analysis for the period 1990-1996. The results suggest symmetrical responses of downstream prices to changes in upstream prices for the periods investigated.

The analysis of the US market has been extended by Borenstein and Shepard (2002). The effects of changes in crude oil prices had been asymmetrically transmitted to the terminal prices in the US for the period 1986-1992.

Backmeier and Griffin (2003) conducted an asymmetrical price change analysis of the US market similar to Borenstein et al. (1997). However the two approaches differ in the sense that Bachmeier and Griffin (2003) used Engle-Granger two step method and daily data, whereas Borenstein et al. (1997) had used weekly data and non standard distribution. As expected, the results differed from what Borenstein et al. (1997) suggested in their work. The authors found no signs of asymmetry for the US market over the period 1985-1998.

Similarly, Kaufmann and Laskowski (2005) examined the US market by using monthly data for the period January 1986 – December 2002. The authors applied asymmetric ECM in order to test for possible asymmetries. Partial evidence was found in this analysis suggesting asymmetries on different petroleum products.

Contín-Pilart et al. (2008) investigated the Spanish retail gasoline market for the period 1993-2004. The authors applied multivariate error correction models in order to capture possible

asymmetries arising after the abolishment of state monopoly refinery. The results of the paper suggested symmetric response of retail gasoline prices to both increases and decreases in the upstream prices for the period investigated as well as two other sub periods (January 1993 - September 1998 and October 1998 – December 2004).

6.2 Describing price dynamics

In this part we will define the concepts describing the dynamics of empirical data and the different econometric tools that we will use in order to analyze the market efficiency in the Turkish downstream petroleum industry.

Firstly, the regression method, properties and assumptions of the dynamic ordinary least square estimations that we are going to use extensively will briefly be presented.

6.3 Dynamic OLS method

In our analysis we have applied Dynamic OLS (Stock & Watson, 1993) in order to build a cointegration model via using "PC Give" econometric modeling software. The reason behind applying Dynamic OLS estimation is to reduce the small sample bias and to provide asymptotically efficient estimates for cointegrated variables. This application includes introducing lags and leads into the equation and choosing the model that maximizes the equation 2 log(L) – k log(n) where L is the likelihood function, k is the number of parameters to estimate, n is the number of observations and log(.) is the Naperian logarithm (Contín-Pilart et al., 2008).

The inclusion of lagged values can also eliminate the autocorrelation due to the fact that the effect of a change in the explanatory variable might only be observed after a period of time.

6.4 Stationarity and unit root testing

In our analysis, stationarity concept is significant to prove that the models that we built via using the data we've chosen do not produce spurious regressions through non-stationary data. Thus we will apply Augmented Dickey Fuller (ADF) Test in order to prove that the process is stationary as well as to conduct unit root test.

The stationarity of data implies market efficiency thus the models that we built on in order to correct these inefficiencies will be based on stationary data. Non stationary data could be corrected as stationary by applying first difference operator. Thus by applying unit root test to the data we use, we could conclude that the data are stationary or non-stationary and if the data are non stationary, we could check whether they have unit roots or not. If the first difference operator is stationary, then we can conclude that the data contain one unit root and are integrated of order 1 to induce stationarity (i.e. $y_t \sim I(1)$ and $\Delta y_t \sim I(0)$).

The rationale behind the ADF test is to compare the t-statistics for δ against a non-standard distribution in order to conclude whether the series contain a unit root or not (MacKinnon, 1996). In order to carry out the unit root tests we have built the below model and perform it for each variable:

$$(EQ1) \quad \Delta y_t = \alpha + \beta t + \delta y_{t-1} + \sum_{i=1}^{k} \delta\gamma \Delta y_{t-i} + \varepsilon_t$$

In this equation, t is the linear time trend, Δ is the first difference operator, ε is the random error term, and k is the order of the augmentation in order to eliminate correlation in the residuals of the regression.

In our analysis we will use the Akaike Information Criterion in order to determine the optimal number of lags in our tests and regressions (Akaike, 1974).

AIC = -2*ln (likelihood) + 2*k

In this equation k is equal to degrees of freedom of the model. Fit is measured negatively by 2*ln (likelihood) (i.e. the larger the value the worse the fit). On the other hand, complexity is measured positively by 2*k. The model with the smallest value of the Akaike Information Criterion is chosen to be better given the fact that two models fit on the same data.

6.5 Cointegration analysis

In order to prove the existence of a long run relationship between fuel prices in Turkey and Brent crude oil prices, cointegration analysis is applied. Theory suggests that crude oil prices and fuel prices are expected to be in a long term relationship in an efficient market. In other words, price shocks originating from crude oil prices could also have an effect on fuel prices in the long term in an efficient market.

In our analysis we applied Engle Granger Test (Engle and Granger, 1987) in order to test whether there exists cointegration between fuel prices and Brent crude oil prices. We first assume that there is a stable long-term relationship between fuel prices in Turkey and Brent crude oil prices and used the model below to test for cointegration.

$$(EQ2) \quad y_t = \theta_0 + \theta_1 x_t + u_t$$

In this equation y is the variable used for fuel price in Turkish liras per liter and x is the Brent crude oil prices in Turkish liras per liter. According to the test, the stationarity of the residuals u_t will prove that these two variables are cointegrated and tend towards long run equilibrium.

In order to reduce small sample bias and to provide asymptotically efficient estimates for cointegrated variables we extended the equation 2 and introduced the equation 1 (i.e. dynamic OLS regression). Thus the steady state long run relationship between fuel prices in Turkey and Brent crude oil prices are represented in equation 1.

6.6 Asymmetric ECM

In the literature, there are three popular methods designed to describe asymmetric price behavior, namely asymmetric error correction model (asymmetric ECM), autoregressive threshold ECM and ECM with threshold cointegration (Grosso and Manera, 2007).

In our analysis, we applied asymmetric ECM method in order to test for possible pricing asymmetries in the Turkish downstream Petroleum Industry. Given the existence of cointegration and long term relationship between two variables, it is possible to build an error correction model in order to analyze price asymmetries arising from different factors. Thus the below asymmetric ECM equation represents a steady state relation among the variables:

$$(EQ3)\quad \Delta y_t = \Phi^+ EC^+_{t-1} + \Phi^- EC^-_{t-1} + \sum_{i=0}^{k} \alpha_i \Delta x_{t-1} + \sum_{i=1}^{k} \beta_i \Delta y_{t-1} + \varepsilon_t$$

In this equation, EC_{t-1} is defined as first difference operator from the steady state cointegration relationship, which is the lagged residual from equation 1. Following Bachmeier and Griffin (2003), Kaufmann and Laskowski (2005) and Palacios, Contín-Pilart and Correljé (2008), we decomposed the error correction term based on changes in Brent crude oil prices:

$EC^+_t = EC_t$ if $\Delta x_t > 0$

$EC^-_t = EC_t$ if $\Delta xt \leq 0$

In this conditional equation, $\Delta x_t = x_t - x_{t-1}$ is referring to changes in the levels of x. Thus by decomposing error correction term and introducing lagged variables into equation, our ECM model is able to capture the price dynamics and asymmetries arising. Asymmetric behavior is being tested by establishing the joint hypothesis H_0: $\Phi^+ = \Phi^-$. In order to test for asymmetries

with this joint hypothesis, we apply Wald Test and compare the F statistics. The rejection of this hypothesis indicates the existence of price asymmetry.

7. EMPIRICAL ANALYSIS

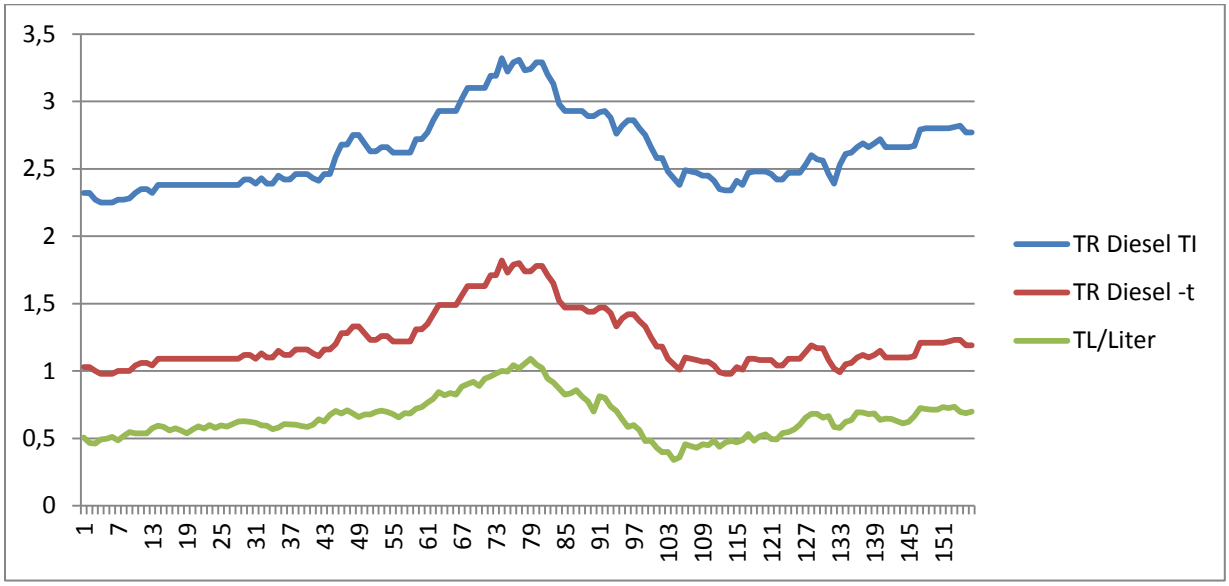
7.1 Data

In our analysis of market efficiency and price asymmetries in the Turkish downstream petroleum industry, we will use the weekly average Euro diesel prices as representative of fuel pump prices (final prices of refinery products) from the beginning of 2007 until the end of 2009. The reason behind that is, by 2009, Euro diesel fuel type sales constituted 21,37% of all petroleum based fuel sales in Turkey that is more than the total of 95 and 98 octane gasoline sales (13,75%) (EMRA, 2009). We will include both before and after tax prices of Euro diesel in order to analyze possible asymmetries arising from taxation and other factors.

For the purpose of testing whether the downstream prices respond symmetrically to changes in upstream prices, we will include Brent crude oil prices into our analysis as representative of upstream prices. Brent crude oil prices are represented in US dollars per barrel; however Turkish downstream prices (pump price of diesel) are represented in Turkish liras per liter. Thus firstly, we converted the US dollars per barrel values to US dollars per liter in order to conduct our analysis on the same unit of measurement. Secondly, Brent crude oil prices of US dollars per liter are converted into Turkish liras per liter via simply using the exchange rate for the respective date of observation. The rationale behind the latter conversion is to eliminate the possible effects of exchange rate fluctuations.

As it can be inferred from figure 7.1, in general, fluctuations in pump prices of diesel has been fairly in line with the fluctuations in Brent crude oil prices exchanged into Turkish Liras. However, by applying pricing asymmetry analysis and dividing the observations into two sub periods, the magnitude of the responses of downstream prices to the changes in upstream prices could be examined. Accordingly, asymmetric price adjustments could be proven statistically through the evaluation of the data with utilizing relevant econometric modeling namely; asymmetric error correction model.

Figure 7.1: Trend lines of diesel prices with tax, without tax and Brent crude oil prices.



Note: TR Diesel TI refers to the Euro diesel price with tax in Turkish liras per liter, TR Diesel –t refers to the Euro diesel price without tax in Turkish liras per liter and TL/Liter refers to the Brent crude oil prices in Turkish liras per liter.

The number of observations included in these analysis amounts to 156 and we will also divide the period between 2007 and 2009 into 2 sub periods (78 observations each) in order to analyze possible asymmetries in these different period of times.

The sample of weekly retail diesel prices includes a sufficient number of data to obtain desirable statistical properties using the regressions and OLS method. However, the strength of the tests would diminish with sub period analysis with lower number of data.

Table 7.1 reveals the main descriptive statistics for diesel prices in Turkey and Brent crude oil prices in Turkish liras per liter. As we could observe, retail diesel prices (both with tax and without tax) have shown more volatility in sub period 1 compared to sub period 2 however the volatility of Brent crude oil price in Turkish liras per liter has remained more stable in terms of standard deviations.

Table 7.1: Descriptive statistics of retail diesel prices in Turkey and Brent crude oil prices.

	Sub Period 1	Sub Period 2	Whole Sample
	Retail diesel prices with tax (in TL/Liter)		
Observation	78	78	156
Mean	2,5968	2,676	2,6364
Std Dev	0,30438	0,22879	0,27215
Skewness	0,9766	0,70016	0,77233
Excess Kurtosis	-0,26104	0,074182	-0,24119
Min	2,25	2,34	2,25
Max	3,32	3,29	3,32
	Retail diesel prices without tax (in TL/Liter)		
Observation	78	78	156
Mean	1,2427	1,2144	1,2285
Std Dev	0,23006	0,19871	0,21542
Skewness	1,1237	1,2227	1,1927
Excess Kurtosis	0,093044	0,7205	0,43799
Min	0,98	0,98	0,98
Max	1,82	1,78	1,82
	Brent crude oil prices (in TL/Liter)		
Observation	78	78	156
Mean	0,67533	0,63439	0,65486
Std Dev	0,15016	0,15746	0,15521
Skewness	1,0034	0,5784	0,73783
Excess Kurtosis	0,066586	0,28242	0,26504
Min	0,46133	0,34025	0,34025
Max	1,0553	1,0911	1,0911

The kurtosis measures whether data are peaked or flat relative to a normal distribution. Thus excess kurtosis measures the deviations from the kurtosis of a normal distribution which is equal to 3. We observe that the deviation from the kurtosis of a normal distribution is quite small in all variables which indicate more homogeneity in prices.

Skewness is considered as a measure of symmetry. We observe a positive coefficient of skewness during all periods for all variables which means that the data have a longer right tail or are right skewed.

Based on kurtosis and skewness, the normality of error term could be tested using the Jarque-Bera test (Jarque and Bera, 1987). It tests for the coefficients of skewness and excess kurtosis being jointly equal to zero.

$JB = n/6\ (S^2 + (K-3)/4) \sim \chi^2$

Where: S = Coefficient of skewness

K = coefficient of excess kurtosis

n = number of observations

Note: See Appendix; Table:10.2 for the Jarque-Bera Test Results.

7.2 Empirical results

7.2.1 Test for stationarity and unit roots

In order to examine the stationarity of the time series data of diesel prices and Brent crude oil prices, unit root tests were conducted for each variable.

Stationarity of variables is important for market efficiency analysis in order to build cointegration and error correction models. Thus we will first check if the data we use exhibit stationarity or non-stationarity by using ADF test with equation 1.

(EQ1) $\Delta y_t = \alpha + \beta t + \delta y_{t-1} + \sum_{i=1}^{k} \delta\gamma\Delta y_{t-i} + \varepsilon_t$

$H_0: \delta=0$

$H_1: \delta<0$

The model above was applied to all variables in all periods by simply inserting the time series data for each variable into the equation as the variable y. The choice of appropriate number of lags *i* to be used in the ADF test is determined by minimizing the Akaike Information Criterion (AIC).

The rejection of the null hypothesis indicates that the time series are stationary. On the other hand not rejecting the null hypothesis indicates the time series is non stationary and contains one unit root.

Table 7.2: ADF test for weekly diesel prices and Brent crude oil prices.

Period	TRDti	ΔTRDti	TRD-t	ΔTRD-t	B	ΔB
Whole Sample	-1.553	-10.24**	-1.558	-10.46**	-1.540	-11.47**
1st Sub	-1.454	-8.939**	-1.337	-9.499**	-0.6417	-10.19**
2nd Sub	-2.220	-7.359**	-2.410	-7.293**	-2.656	-8.530**

Notes: B: Brent crude oil prices in TL/Liter, TRDti: Diesel prices (Tax included), TRD-t: Diesel prices without tax and Δ *indicates fist lag difference operator. Critical values are 5%= -3,47 and 1%= -4,08*

The null hypothesis of unit root is rejected when the test statistic is more negative than the critical value. Results on Table 7.2 reveals that all the variables contain one unit root while their first differences are stationary, indicating that all the variables are integrated of order one or *I(1)* for all periods.

7.2.2 Test for cointegration

In the case of time series data that are integrated of order one, there may exist a stable long run economic relationship between diesel prices in Turkey and Brent crude oil prices. The cointegration method allows us to investigate long term relationship between non stationary series. The logic behind cointegration test is to regress to non-stationary variables and test whether the residuals from this equation are stationary.

In order to test for cointegration we have applied the below model in which we regressed both diesel prices in Turkey with and without tax to Brent crude oil prices.

(EQ2) $y_t = \theta_0 + \theta_1 x_t + u_t$

Then we stored the residuals from each equation and applied an ADF test for these residuals in order to check for stationarity. Equation 1 is estimated for all these residuals in order to apply the unit root test.

(EQ1) $\Delta y_t = \alpha + \beta t + \delta y_{t-1} + \sum_{i=1}^{k} \delta\gamma \Delta y_{t-i} + \varepsilon_t$

Table 7.3: ADF test results for residuals from equation (1).

Period	Residuals TRDti	Residuals TRD-t
Whole Sample	-2.487*	-2.283*
1st Sub	-3.824**	-4.619**
2nd Sub	-2.749**	-2.310*

Notes: TRDti: Diesel Prices (Tax included), TRD-t: Diesel Prices without tax.
Critical values for the whole sample are 5%=-1.94 1%=-2.58
Critical Values for the sub periods are 5%=-1.95 and 1%=-2.60.

The results from the above table reveal that all the residuals are stationary indicating that they are integrated of order 0 or I(0). Thus we can conclude that both diesel prices in Turkey with and without taxes are cointegrated with Brent crude oil prices.

7.2.3 Modeling asymmetric ECM

As a result of a cointegration relation existing between diesel prices and Brent crude oil prices, we could build our asymmetric ECM model in order to test for asymmetries between these two variables. Engle and Granger (1989), in their analysis, introduced decomposing the error terms in order to capture the short-run dynamics. Thus by plugging in the lagged residuals from the steady state cointegration relationship which is equation (1) into the error correction model, we tested the price asymmetries for the Turkish downstream petroleum industry with the following asymmetric ECM model;

(EQ3) $\Delta y_t = \Phi^+ EC^+_{t-1} + \Phi^- EC^-_{t-1} + \sum_{i=0}^{k} \alpha_i \Delta x_{t-1} + \sum_{i=1}^{k} \beta_i \Delta y_{t-1} + \varepsilon_t$

Where;

$EC^+_t = EC_t$ if $\Delta x_t > 0$

$EC^-_t = EC_t$ if $\Delta xt \leq 0$

In this conditional equation, $\Delta x_t = x_t - x_{t-1}$ refers to changes in the levels of x. Thus by decomposing the error correction term and introducing lagged variables into equation, our ECM model is able to capture the price dynamics, asymmetries arising. Asymmetric behavior is being tested by establishing the joint hypothesis H_0: $\Phi^+ = \Phi^-$. In order to test for asymmetries with this joint hypothesis, we apply Wald Test and compare the F statistics. The rejection of this hypothesis indicates the existence of price asymmetry.

Thus we test;

H_0: $\Phi^+ = \Phi^-$ against H_A: $\Phi^+ \neq \Phi^-$

7.2.4 Results

Table 7.4 shows the results of the asymmetric ECM model that we built on equation (3) where we tested the above hypothesis in order to observe possible asymmetries arising in the Turkish downstream petroleum industry between years 2007 and 2009.

Table 7.4: Estimates of coefficients and test results of asymmetric ECM model.

	Sub Period 1	Sub Period 2	Whole Sample
	y = Retail diesel prices with tax (in TL/Liter)		
EC^{+}_{t-1}	-0,686209 (-3,01)	-0,147784 (-0,691)	-0,123440 (-1,73)
EC^{-}_{t-1}	-0,650205 (-2,97)	-0,417443 (-2,52)	-0,173423 (-2,62)
Δx_{t-1}	0,0171705 (0,171)	0,0880698 (0,771)	0,000359262 (0,00462)
Δx_{t-2}	-	-	-
Δx_{t-3}	-	-	-
Δy_{t}	0,437706 (2,45)	0,547735 (3,97)	0,504647 (4,62)
Δy_{t-1}	1,24859 (6,26)	0,481805 (2,99)	0,647422 (5,10)
Δy_{t-2}	-	-	-
Δy_{t-3}	-	-	-
Sigma	0,0361636	0,045228	0,0425664
D.W.	2,19	2,09	2,04
Wald Test (F)	8.2495 [0.0006]**	3.2389 [0.0452]*	4.4462 [0.0134]*
Observation	73	74	146
	y = retail diesel prices without tax (in TL/Liter)		
EC^{+}_{t-1}	-1.03057 (-4.31)	-0.208533 (-1.19)	-0.127401 (-1.97)
EC^{-}_{t-1}	-0.659627 (-2.98)	-0.142735 (-1.19)	-0.0883914 (-1.25)
Δx_{t-1}	-0.0121650 (-0.108)	0.0218197 (0.198)	-0.0353478 (-0.460)
Δx_{t-2}	0.0418778 (0.444)		
Δx_{t-3}	-		
Δy_{t}	0.331025 (2.40)	0.491447 (4.59)	0.423994 (4.88)
Δy_{t-1}	1.04956 (6.95)	0.453936 (3.56)	0.567047 (5.71)
Δy_{t-2}	0.373744 (2.40)		
Δy_{t-3}	-		
Sigma	0.027606	0.0352423	0.0339952
D.W.	1.92	2.19	2.13
Wald Test (F)	12.396 [0.0000]**	1.2691 [0.2876]	2.4770 [0.0876]
Observation	73	73	146

*Notes: Values in brackets for coefficients are the t values, D.W. represents the Durbin Watson statistics of the models and the values in brackets for Wald Test F statistics are respective F statistics to compare in order to test the Hypothesis H_0: $\Phi^{+} = \Phi^{-}$ (** indicates that the hypothesis is rejected with 1% significance level and * indicates 5% significance level).*

Thus, the results of the Wald Tests reveal that there exist asymmetries between retail diesel prices with tax and Brent crude oil prices for both sub periods and the period between 2007 and 2009 whereas there exists asymmetry between retail diesel prices without tax and Brent crude oil prices only in sub period 1; for sub period 2 and for the whole sample there is symmetrical relationship between retail diesel prices and Brent crude oil prices. The results and reasons of these asymmetries will be discussed in detail in the conclusion part.

In order to gain a deeper understanding of asymmetrical adjustment of prices, it is also possible to comment on the direction of asymmetries by comparing the magnitudes of the positive and negative error correction terms. In other words, in order data to support the common perception of slower adjustment of downstream prices to decreases in crude oil prices than to increases, the coefficient value of EC^{+}_{t-1} should be greater EC^{-}_{t-1}, in absolute terms.

It is revealed on Table 7.4 that absolute value of the coefficient value of EC^{+}_{t-1} is greater than the absolute value of the coefficient value of EC^{-}_{t-1} for sub period one in both estimations; estimation one using the retail diesel prices with tax (in TL/Liter) and estimation two using the Retail Diesel Prices Without Tax (in TL/Liter) as the representative of downstream prices).

However, for the first estimation using diesel prices with tax, there is also proven asymmetry (with 5% significance level) in the second sub period as well as the whole period of estimation one with the coefficient value of EC^{+}_{t-1} is being less than the coefficient value of EC^{-}_{t-1} in absolute terms. This result indicates that decreases in crude oil prices were transmitted to the fuel prices with taxes faster than the increases in crude oil prices for respective periods. On the other hand when we look at the t values of the coefficients individually, it is observed that the coefficients of EC^{+}_{t-1} for the sub period 2 and the whole sample are not statistically as strongly significant as the other models with asymmetry. Additionally, the models with diesel prices with tax for the sub period 2 and the whole sample are revealing weak form asymmetry due to 5% significance level of asymmetry hypothesis rejection.

8. CONCLUSIONS

The aim of this paper is to analyze the downstream petroleum market in Turkey in terms of pricing, market structure and efficiency. Market efficiency is highly dependent on pricing structure and asymmetric pricing transmission is a source of market inefficiency.

In our empirical analysis, possible asymmetrical adjustments of final pump prices of fuel in Turkey to changes in crude oil prices have been investigated through an asymmetric error correction model. Weekly diesel prices had been chosen to be included in our analysis as representative of final pump price in Turkey due to the fact that diesel has the highest share of consumption among other petroleum products consumed in Turkey. On the other hand, Brent crude oil prices are being used as upstream prices and the respective price in US dollars per barrel is converted to Turkish liras per liter by using weekly exchange rate and relevant conversion rate from barrel to liter.

In order to capture the effect of tax on possible asymmetric price adjustments arising in the Turkish downstream petroleum market, we estimated the asymmetric error correction model for both the diesel price with and without tax.

Table 8.1: Results of asymmetry analysis.

	First Period	Second Period	Whole Sample
	Y=Brent crude oil prices		
X= Diesel prices without tax	Asymmetry (**)	Symmetry	Symmetry
X= Diesel prices with tax	Asymmetry (**)	Asymmetry (*)	Asymmetry (*)

Notes: (*) indicates that the hypothesis for symmetry is rejected with 5% confidence level, (**) indicates that the hypothesis for symmetry is rejected with 1% confidence level. First period: January, 05, 2007 – June, 27, 2008, Second Period: July, 04, 2008 – December, 25, 2009.

The table 8.1 reveals the results of our empirical analysis. As we've discussed in previous chapters, our analysis is built on two sub periods as well as the whole period that is from

January 2007 to the end of December 2009. As we can observe from table 7.1, there is evidence for asymmetrical pricing behavior in the sub period 1 both in the estimations using diesel prices with and without tax. As expected, asymmetrical pricing behavior in the 1st sub-period is in the form of slower adjustment of diesel pump prices to decreases in crude oil prices than the increases. This result is also supporting the decisions and reports of the regulatory mechanisms in Turkey for the same period. On the other hand, we observe weak asymmetrical pricing behavior in the second sub sample and the whole sample regarding the estimations with diesel prices with tax. Statistically, the proven asymmetry is in the weak form with low confidence levels indicating decreases in crude oil prices were transmitted to the fuel prices with taxes faster than the increases in crude oil prices for respective periods. The reason behind this unexpected result can be related to the price ceiling regulation in the second sub period. It is considered as a market intervention resulting in decreasing distributor and retailer margins, however increasing taxes for the respective period. Thus the resulting weak asymmetry in the models with taxes could be the result of this market intervention where the ceiling prices were set by the regulation authority.

In our analysis, as we've discussed before, we used the Brent crude oil prices as representative of upstream prices. Then we converted the dollar per gallon prices into Turkish Lira per liter prices in order to eliminate the effect of exchange rate fluctuations on the crude oil prices. The conversion of gallon to liter has also allowed us to conduct our analysis on the same measurement levels.

In order to explain the reasons behind the asymmetrical price adjustments in Turkish downstream petroleum markets, stakeholders must be defined to assess their contribution and influence on the existing asymmetry. Thus the stakeholders include the monopoly positioned refinery (TUPRAS), five biggest retailers holding around 80% market share of the downstream petroleum market, distributors operating the fuel stations, government levying special consumption and value added taxes on petroleum products and the Energy Market Regulatory Authority (EMRA). We will analyze the roles and the impacts of these stakeholders on existing price asymmetries and propose suggestions regarding what would force them to reduce or eliminate the existing asymmetric pricing behavior.

As we've mentioned in previous chapters, TUPRAS has the monopoly position as the sole refinery operating in Turkey and had been privatized in January 2006. Before privatization, financial reports of TUPRAS were indicating negative operating profit supporting the fact that

the technology was old and the productivity rate was quite low compared to the other refineries in Europe. After privatization, there had been significant investment in order to improve the technology and productivity rates. On the other hand, it is observed from figure 4.3 in chapter 4 that distributor margin and retailer margin contribute around 6% each to the final pump price compared to around 33% contribution of refinery pricing. Thus it is supported that as a monopoly compared to competitive (close to oligopoly) structure of retailers market, TUPRAS as a sole refinery has significant pricing power. If we revisit chapter 4, it is indicated that the refinery margins increased above the Mediterranean average margin level for the period 2007 and mid 2008. This might be due to the reason that the significant investment done by the private owner of TUPRAS was paying pack, increasing the productivity levels and decreasing the costs resulting in higher margins for the refinery. Thus, the roots of asymmetric pricing could highly be related to this transition period where the profits coming from increasing petroleum prices had been captured by the refinery.

The market shares of five big players in the retail industry are also important to consider in terms of market power. As explained in chapter 4, retail and distributer prices of fuels in Turkey are significantly higher than the ones in UK and the US. This difference is highly related to the relatively higher operating costs of fuel stations in Turkey due to much more workers employed. To illustrate, unlike most of the other countries, fuel stations in Turkey employ pumpers and car washers adding extra costs on operating these stations. Thus the cost of additional labor force is limiting the affect of downward movements of crude oil prices, enabling less flexibility on price decreases.

On the other hand, as also stated by the Competition Authority (Gunduz et al., 2008), retail companies set ceiling prices for petroleum products to the fuel stations. Fuel stations take this price as the final pump price allowing the retail companies to be price setters in the distribution segment too. Moreover, as stated by EMRA, the retail companies are obliged to share these ceiling prices to the public allowing the other players to get price information of their competitors. Thus this situation limits the price competition allowing five big retail companies (holding around 80% of the downstream market) to retain their pricing power; thusly creating an oligopolistic market.

In terms of downstream profitability, Turkey outperforms all EU countries together with the relatively higher fuel prices in all segments. It is a fact that the taxes and exchange rates play a role in high fuel prices; however it does not change the fact that the downstream profitability

figures are much higher than the European average. This fact has been mentioned many times in the annual petroleum sector reports of EMRA and the players in the downstream market are warned about this price distorting situation. In the end, as argued fiercely by downstream players, EMRA banned the promotional activities of the distributors and retailers (offers of gifts etc.) and imposed a price ceiling in the summer of 2009 for two months. In modern economic theory, these non-market price interventions are not favored due to the fact that the prices in a competitive market are set by market forces. However, in this situation, EMRA decided that there exists an oligopolistic downstream market structure in Turkey and used its right to intervene with price ceiling.

It is important to stress out the fact that in our analysis, we found asymmetry in the first sub period (January, 05, 2007 – June, 27, 2008) where the Competition Authority submitted its report regarding the distortions in the competition of downstream market. The report concluded that the retail prices are less sensitive to the downward movements of crude oil prices than upward movements. This report supports our empirical results of asymmetrical pricing behavior in the period from January, 05, 2007 to June, 27, 2008 both with our estimations through diesel prices with tax and without tax.

As we've discussed before this asymmetry may arise from different factors and by law EMRA is the regulatory mechanism to fix this problem. Our analysis suggest that the resulting asymmetry might stem from retail pricing or refinery pricing since we exclude the exchange rate and taxes in our estimation through diesel prices without tax. What EMRA missing in its analysis is not considering the fact that although TUPRAS is pricing its products within the 3% mark-up allowed (by law) against the referenced CIF Mediterranean prices, the resulting asymmetrical pricing behavior in the downstream market is also related to the refinery pricing. This argument is highly supported by the significant pricing power of TUPRAS as a monopoly and well notable above Mediterranean average profit margins observed in 2007, 2008 and 2009. As stated in the petroleum law, the 3% mark-up advantage gives the refinery the right to increase its prices up to 3% of referenced CIF Mediterranean price increases and on the other hand when the referenced CIF Mediterranean prices decreases the law allows the refinery to reflect this price decrease less than 3%. The aforementioned situation certainly allows the refinery to engage in asymmetric pricing behavior which is supported by law.

In order to overcome with this issue, the strong monopoly position of TUPRAS should be discouraged via enabling other players to enter the market. It is also significantly important to increase the number and the size of storage facilities in order the imported petroleum products to compete better with TUPRAS's products in terms of costs of storage. This will force TUPRAS to lower its product prices.

It is also noteworthy, as stated in the report of the Competition Authority, that the retail and distribution margins are much above the European average allowing downstream players to gain excessive return. It can be observed that the retailers react faster than the refinery to increases in crude oil prices by raising the prices of their petroleum products. In other words, when the crude oil prices increase, the pump prices of fuels are being raised before TUPRAS increases it petroleum product prices. However the reverse situation (the decreases in crude oil prices) is not reflected as fast as the increases in the upstream prices. Moreover, the Competition Authority implied in its fuel sector report that there exists an oligopolistic market structure distorting competition in the downstream petroleum sector; supported by EMRA's decision on banning promotion activities of fuel stations and imposing price interventions (price ceiling). All these arguments support the fact that the resulting asymmetrical pricing behavior in our empirical studies is also related to the lack of competition in retail market allowing the players to gain significantly higher profits compared to other countries.

Compared to the monopoly position of the refinery in the sector, there are around 40 active players in the retail market; however the five biggest players in the sector share around 80% percent of the market. As we've stated before, in order to increase the competition in the market and allow small sized players to gain further market share, EMRA passed a regulation to lower the duration of the contracts with distributors. This will enable more competition in the market.

On the other hand, EMRA's intervention in order to prevent oligopolistic structure in the retail sector resulted in lower distributor and retailer margins. One can say that the regulation was effective, however when we look at the bigger picture, it is observed that the resulting decrease in retail and distributor margins is captured by the government via increased taxes (special consumption tax). Thus the tax burden on fuel products increased further, resulting consumers to still pay the highest fuel price in Europe.

Thus it is suggested in our empirical analysis; the resulting asymmetry is also related to the pricing strategies and existing oligopolistic market structure in the retail sector. The role of EMRA is highly significant in this situation to overcome this market imperfection. Instead of implying short term solutions as price ceilings (for 2 months), EMRA needs to encourage structural changes in the sector. Shortening the duration of contracts with distributors is an example of these structural changes. Furthermore, the retailers impose ceiling prices to its distributors and as expected these ceiling prices are becoming the actual prices for these contracted fuel stations. This situation creates similar prices for the distributors in the same regions blocking the possible price competition and disabling lower prices. It is highly important for EMRA to further change these rules to favor competition in the market and enable structural change in the long term towards a competitive market.

On the other hand as recommended in the IEA report (2009), a light handed regulation should be implemented in order to ensure competition and sufficient investment as a response to increasing demand of refining, transportation and storage capacity. This is possible in the Turkish downstream petroleum sector via creating a separate regulatory mechanism only responsible with the downstream part of the sector. Energy Market Regulatory Authority is responsible for all Energy markets and the department that is responsible for petroleum industry is responsible for both downstream and upstream sector.

In order for the regulatory mechanism to implement better policies to secure competition in the downstream market, a continuous inspection and control should be followed in the sector. Thus a single Downstream Petroleum Market Regulation Authority could perform more efficiently to realize this goal letting the market to operate in a better structured way.

It is also highly important to stress out the effect of taxation on high fuel prices in Turkey and its effect on pricing behavior in the sector. As we've explained before, taxation on petroleum products in Turkey is considered to be the highest in Europe and around 60% of the pump price of diesel is consisted of taxes. In this perspective, government has a strong tool in its hand as an excise tax called special consumption tax in terms of its effect on final prices petroleum products. Unlike value added tax, special consumption tax is an excise tax open to changes at anytime and had been increased frequently since it was first introduced in 2002. Thus taxation through changes in special consumption tax may contribute to the asymmetrical pricing behavior, when asymmetric error correction models include fuel price with tax.

When we consider the share of tax revenues stemming from petroleum products taxation on total tax revenues of Turkish government, a decrease in the special consumption tax is not expected in the short term. Thus the effect of taxation on fuel pricing is mostly further increases in fuel prices when the crude oil prices increase or stay stable and if the amount of special consumption tax increases when the crude oil prices decreases then the overall effect is more ambiguous. In other word, taxation could cause stickiness of fuel prices to the downward movements of crude oil prices or could cause the opposite effect with further increases in crude oil prices during crude oil price increases.

Besides picturing the current market structure in Turkish downstream petroleum market, the contribution of this thesis to the current literature is the empirical proof of asymmetrical pricing behavior in the downstream sector as also suggested in the fuel sector report of the Competition Authority. Thus our analysis supports the results of this report empirically via applying econometrical methods such as cointegration methods and asymmetric error correction models; providing thorough analysis of the various factors behind possible asymmetries and reaching a competitive and efficient downstream market in terms of structure and stability. The previous studies on the efficiency of the Turkish downstream petroleum market are limited and rather outdated. Furthermore, they don't specifically contribute to the discussion of fuel sector report results of the Competition Authority and the criticism regarding the activities of regulatory mechanisms in the period from 2007 to the end of 2009.

Further research can be conducted in this manner to analyze determinants of existing asymmetrical pricing behavior in the market. It is also the Competition Authority's responsibility to analyze the pricing behavior of the monopoly positioned refinery in order to conclude whether the current mark-up advantage of the refinery is being abused via practicing sticky prices to the downward movements of crude oil prices.

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10. APPENDIX

Table 10.1: Crude oil production in OECD countries from 2002 to 2008, in million tons.

	2002	2003	2004	2005	2006	2007	2008
Australia	31,3	29,1	26,2	22,9	21,9	24	22,2
Austria	1	1	1,1	1	1	1	1
Canada	132,9	140,4	145,4	143,5	151,3	156,8	154,6
Czech Republic	0,4	0,5	0,6	0,6	0,4	0,4	0,4
Denmark	18,1	18,1	19,3	18,5	16,8	15,2	14
Finland	0,1	0,1	0,1	0,1	0,2	0,1	0,1
France	1,5	1,6	1,6	1,4	1,1	1,1	1,1
Germany	4,6	4,8	4,9	5,2	5,2	5,2	4,9
Greece	0,2	0,1	0,1	0,1	0,1	0,1	0,1
Hungary	1,6	1,6	1,6	1,4	1,3	1,2	1,2
Italy	5,8	5,9	5,7	6,4	6,3	6,6	6,3
Japan	0,6	0,6	0,7	0,7	0,7	0,7	0,7
Korea	0,5	0,5	0,4	0,5	0,6	0,6	0,5
Mexico	178,3	189,3	191,4	187,6	183,2	175,4	159,5
Netherlands	3,1	3,1	2,9	2,3	2	3	2,5
New Zealand	1,6	1,2	1,1	1	1	2	2,8
Norway	157,7	153,6	143,9	132,8	123,6	119,4	107,2
Poland	0,8	0,8	0,9	0,9	0,8	0,7	0,8
Slovak Republic	0,1	..	..	..	..	..	..
Spain	0,3	0,3	0,3	0,2	0,1	0,1	0,1
Turkey	**2,4**	**2,4**	**2,3**	**2,3**	**2,2**	**2,1**	**2,2**
United Kingdom	116,1	106,2	95,5	84,7	76,6	76,8	72,2
United States	348,1	338,4	325,9	310	304,4	304	300,5
EU27 total	161,5	151,7	140,7	129	118	116,8	..
OECD total	1007,1	999,8	971,9	924,1	900,8	896,7	854,9
Brazil	75,6	77,9	77,6	85,7	90,8	92,4	..
Chile	0,4	0,4	0,4	0,3	0,3	0,5	..
China	167,1	169,7	175,9	181,4	184,9	186,4	..
India	37,4	37,7	38,3	36,3	38,1	38,2	..
Indonesia	62,8	59,4	54,9	51,4	48,2	45,3	..
Israel [1]	..	..	..	..	..	..	..
Russian Federation	377,2	418,6	456,3	466,4	475,8	487,7	..
South Africa	1	0,7	1,7	1,7	1,5	1,2	..
World	3599,2	3723,4	3857,7	3914,3	3926	3915,4	..

Source: OECD statistics database, (2009)

Table 10.2: Jarque-Bera normality test results for the variables diesel prices with and without tax and crude oil prices.

	Normality test: Chi^2(2)		
Prices/Period	Sub 1	Sub 2	Whole Period
Diesel (tax included)	43.136 [0.0000]**	9.4196 [0.0090]**	39.279 [0.0000]**
Diesel (without tax)	53.131 [0.0000]**	44.250 [0.0000]**	107.75 [0.0000]**
Crude oil (TL/Liter)	33.832 [0.0000]**	4.7242 [0.0942]	20.272 [0.0000]**