3
Data

3.1
Data Description

The main source of data used in our work was a survey carried out by the national petroleum agency (ANP) that monitors ethanol and gasoline prices over 38 municipalities in the state of Rio de Janeiro. More specifically, the ANP verifies the price charged by fuel stations and the price stations pay to fuel distributors. Besides, the survey shows the brand of the station (or if it has no brand), the date prices were collected and the address of the station. This survey was conducted on a weekly basis and the time period considered goes from January, 2002 to March, 2008.

Not all stations are surveyed during the same week. According to conversations with ANP's employees, coverage is 100% in cities with a small number of stations, while in other areas the stations surveyed vary from week to week.

Since this work focus on the competitive effect of the introduction of flex fuel cars in the retail fuel market, we also used data on number of cars by fuel type in each city. The data consists of the number of cars according to fuel type (gasoline, ethanol, flex, gasoline + CNG[4], ethanol + CNG, flex + CNG) at monthly frequency. The time period is the same considered in the ANP's survey (from January, 2002 to March, 2008). This data base was provided by the traffic department of the state of Rio de Janeiro (Detran – RJ).

[4] Compressed Natural Gas

Although ANP verifies the price charged by fuel stations in all Brazilian states, we are not able to expand our analysis to the entire Brazilian territory because we do not have access to data on the number of cars by fuel type in other states.

Aside from the data previously mentioned, we also included in our analysis a gas station employee's minimum wage in the state of Rio de Janeiro. That wage changes every year by force of law together with the general minimum wage, but it is higher than the latter. We believe this variable is a good proxy for an important source of costs for fuel stations. It does not vary across cities within the state.

We also used other characteristics of municipalities, such as the municipal GDP per capita, which is an important variable to determine the income level in each city. Besides, we included an approximation of the number of fuel stations per vehicle and an approximation of the number of hotels per km^2 in each city.

3.2

Descriptive Statistics

Table 1: Stock of Vehicles and Percentage of Flex Cars by City

	2004		2007	
	Number of Vehicles	Percentage of Flex Cars	Number of Vehicles	Percentage of Flex Cars
Mangaratiba	3.090	1,2%	4.812	14,1%
Niterói	176.647	1,0%	194.511	12,4%
Macaé	41.048	1,1%	57.261	11,1%
Rio de Janeiro	1.800.614	0,8%	1.969.128	10,5%
Armação de Búzios	4.340	1,4%	6.703	10,5%
Angra dos Reis	21.503	0,9%	27.030	10,0%
Parati	2.937	0,6%	3.675	9,1%
Maricá	14.193	0,7%	24.120	9,0%
Resende	26.085	0,8%	33.368	8,9%
Cabo Frio	32.315	1,0%	46.371	8,6%
Nilópolis	24.305	0,5%	29.579	7,4%
Três Rios	14.792	0,9%	18.246	7,3%
Araruama	20.290	0,6%	28.037	7,2%
Saquarema	9.955	0,6%	13.771	7,1%
Barra Mansa	31.788	0,8%	36.420	6,9%
Vassouras	7.297	1,0%	8.319	6,9%
Volta Redonda	68.441	0,7%	81.203	6,7%
Paraíba do Sul	6.101	0,8%	7.427	6,5%
São Gonçalo	107.977	0,4%	134.860	6,5%
Petrópolis	86.912	0,6%	97.177	6,3%
Sapucaia	1.381	0,9%	1.508	6,2%
Belford Roxo	26.574	0,3%	37.744	6,1%
Teresópolis	42.920	0,5%	50.787	5,6%
Queimados	9.278	0,3%	13.612	5,6%
Nova Iguaçu	115.523	0,4%	137.337	5,5%
Magé	21.034	0,4%	27.495	5,5%
Duque de Caxias	128.426	0,3%	151.257	5,3%
Nova Friburgo	60.539	0,4%	68.588	5,3%
Itaguaí	28.016	0,2%	31.609	4,6%
valenca	10.297	0,3%	11.540	4,5%
São João de Meriti	64.607	0,2%	76.891	4,4%
Rio Bonito	22.251	0,5%	35.453	4,4%
Itaboraí	27.800	0,3%	37.075	4,3%
Barra do Piraí	18.436	0,5%	21.239	4,3%
Santo Antônio de P.	9.234	0,7%	10.540	4,2%
Itaperuna	18.810	0,6%	22.123	3,8%
Campos dos G.	91.651	0,3%	109.388	2,6%
São Francisco de I.	3.395	0,3%	4.204	2,3%
Total	3.200.802	0,7%	3.670.408	8,8%

The table above shows how the percentage of flex cars varied between 2004 and 2007 in the 38 cities that will be analyzed. As we can see, the percentage of flex cars grew considerably across time in all the cities, reaching a maximum value of 14.1% in the city of Mangaratiba in 2007. We may notice that it varied between 2.3% and 14.1% in 2007, a fact that indicates a large dispersion of this variable across cities.

Table 2: Gasoline and Ethanol Prices, Costs and Margins (in R$)

	Observations	Mean (R$)	Standard Deviation	Min	Max
Ethanol Price	266,030	1.510	0.331	0.600	2.879
Ethanol Cost	154,185	1.253	0.338	0.278	2.527
Ethanol Margin	154,185	0.249	0.133	-0.927	0.964
Gasoline Price	286,126	2.279	0.332	1.299	3.119
Gasoline Cost	198,866	2.015	0.298	1.140	2.846
Gasoline Margin	198,866	0.258	0.104	-0.747	1.469

Table 2 above provides basic statistics about fuel costs, prices and margins in the state of Rio de Janeiro. We can notice that gasoline price is, on average, higher than the ethanol price. However, the standard deviations of the fuel prices are very similar. The same conclusion follows when we compare fuel costs or fuel margins. We can see that fuel margins are less volatile than fuel prices and costs. Since the final price is equal cost plus margin, we can conclude that the major part of variation in prices is due to costs, not to margins.

Although we did not have access to data on gasoline and ethanol sales at stations, the ANP publishes the distributors' consolidated sales volume in the state of Rio de Janeiro, as shown in table 3. We can observe that gasoline sales have always been larger than the ethanol one. Notwithstanding, ethanol sales have been growing at high rates since 2004 while gasoline sales have been falling.

Table 3: Distributors' Fuels Sales in the State of Rio de Janeiro (in cubic meters)

	Gasoline Sales	*Variation*	Ethanol Sales	*Variation*
2000	1,847,747	-	232,189	-
2001	1,772,337	*-4%*	155,572	*-33%*
2002	1,971,934	*11%*	157,567	*1%*
2003	1,764,595	*-11%*	98,178	*-38%*
2004	1,848,172	*5%*	109,817	*12%*
2005	1,739,319	*-6%*	180,528	*64%*
2006	1,660,803	*-5%*	224,255	*24%*
2007	1,635,152	*-2%*	359,404	*60%*

We can note in table 4 that ethanol retail average prices are below 70% of gasoline retail average prices, except for the year of 2006. Remembering that flex car sales started at the beginning of 2003, we may at least suspect that the introduction of this new type of car in the market has contributed to raise consumption of ethanol. Thus, it is reasonable to infer that many owners of flex cars are choosing to fill their tanks with ethanol and this fact may help us identify the competitive effect generated by flex cars on gasoline and ethanol retail markets.

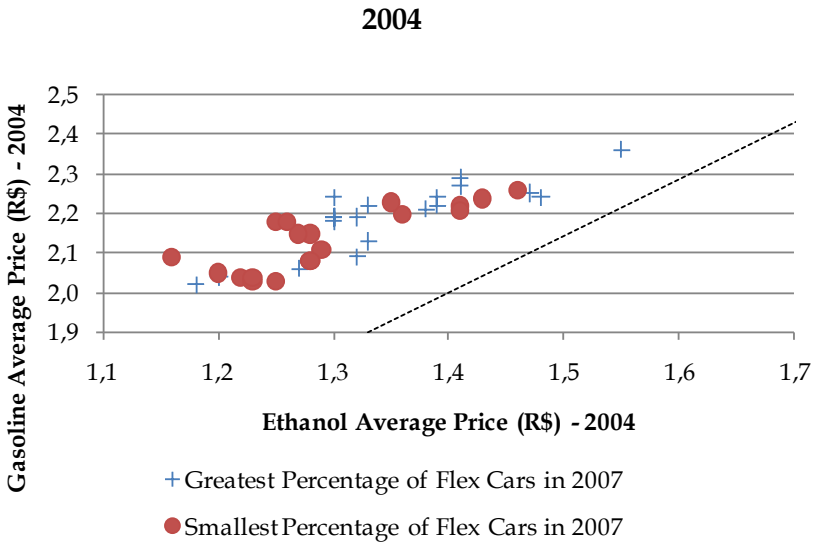
Table 4: Gasoline and Ethanol Average Prices by Year in the State of Rio de Janeiro (in R$)

	Ethanol Price	Gasoline Price	*Ethanol Price/ Gasoline Price*
2002	1,06	1,71	*0,62*
2003	1,40	2,12	*0,66*
2004	1,30	2,11	*0,61*
2005	1,56	2,37	*0,66*
2006	1,88	2,60	*0,72*
2007	1,70	2,57	*0,66*

The graphs below plot average gasoline prices versus ethanol average prices by city. The prices in 2007 are deflated. The circles represent the 19 cities with the smallest percentage of flex cars in 2007,

while the crosses are the 19 cities with the greatest percentage of flex cars in 2007.

Figure 2: Gasoline and Ethanol Average Prices by City - 2004

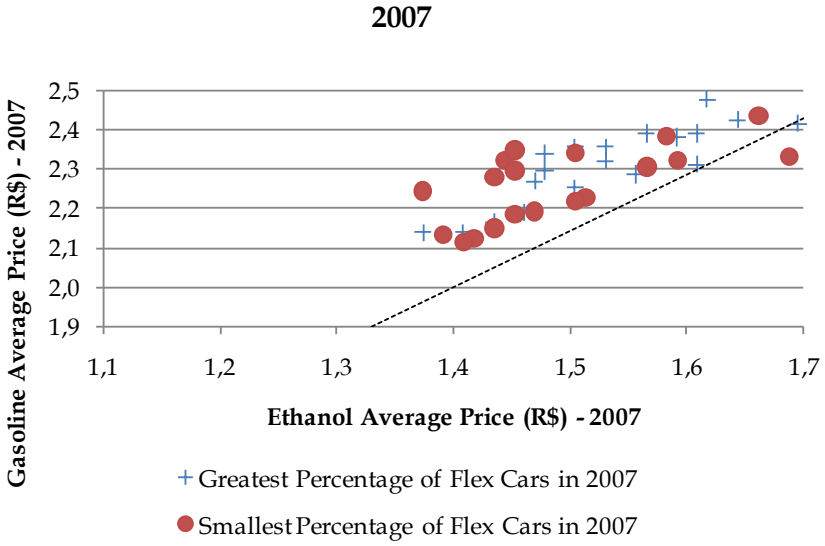


The dashed line correspond to the break even ratio where $\frac{\text{Ethanol Price}}{\text{Gasoline Price}} = 0.7$.

If prices in a given city fall on the dashed line, a consumer in the city will be indifferent between ethanol and gasoline, according to Marjotta-Maistro and Asai (2006).

The graphs show that the points in 2007 are closer to the break even curve than in 2004. One possible explanation for this effect is that an increase in the number of flex vehicles is causing the relative prices in the cities to move closer to the break even curve. It is important to point out that this explanation would also imply the group of cities with the highest percentage of flex cars to be closer to the break even curve than the other group of cities. However, we cannot see this pattern in the graphs.

Figure 3: Fuel Average Deflated Prices by City - 2007



Ferreira, Prado and Silveira (2007) verify if ethanol and gasoline price levels are cointegrated and if their relative price is stationary. They use data on prices charged by ethanol and gasoline producers. They find evidences of a stationary relative price and, hence, cointegration between the fuel prices. They estimate an equilibrium level for relative prices of 0.52, below the 0.7 previously mentioned. They argue that this difference might be due a lower cost structure of the ethanol or to the fact that the amount of flex cars in the market until that moment may not have been sufficient to raise the relative price.