5
Results

Tables 5 and 6 show the main results obtained for gasoline and ethanol, respectively.

Table 5: Regressions - Gasoline Prices

Dependent Variable: Gasoline Price

	(1)	(2)	(3)
%Flex	**0.03684*** **	**-0.01767*** **	**-0.01810*** **
	(0.00151)	**(0.00127)**	**(0.00125)**
(%Flex) . (Ethanol Price)	**-0.01575*** **	**0.00980*** **	**0.00992*** **
	(0.00084)	**(0.00066)**	**(0.00067)**
Gasoline-Powered Cars	-0.01787***	-0.00749***	-0.00451***
	(0.00209)	(0.00149)	(0.00106)
Gasoline Cost	0.86217***	0.30283***	0.29824***
	(0.00496)	(0.00740)	(0.00740)
Ethanol Price	0.17259***	0.17077***	0.16418***
	(0.00415)	(0.00314)	(0.00315)
Minimum Wage			0.00246***
			(0.00004)
GDP per Capita			-0.00087***
			(0.00032)
(Total Stations)/(Gasoline-Powered Cars)			-0.00022***
			(0.00003)
Hotels per km²			0.13789***
			(0.03041)
Constant	0.36493***	1.10629***	0.32408***
	(0.01387)	(0.01727)	(0.01552)
Month Fixed-Effects	No	Yes	Yes
City Fixed-Effects	Yes	Yes	No
Brand and Station Fixed-Effects	No	No	Yes
Observations	180807	180807	180092
Number of Groups	2131	2131	2131

Robust standard errors in parentheses -
(robust to heteroskedaticity and to correlation of the residuals within a city in a given week)
* significant at 10%; ** significant at 5%; *** significant at 1%

The main regression of each table is presented in the last column (regression number 3). The coefficients of the variable %Flex are both negative and significant at the 1% level. This confirms our prior that an increase in the percentage of flex cars reduces fuel prices. The effect is stronger on gasoline price (-0.01819) than on ethanol price (-0.01429). The size of this effect is relevant, since a 10% increase in the percentage of flex cars reduces gasoline and ethanol retail prices in approximately 18 and 14 cents, respectively.

Ethanol price is much more sensitive to changes in gasoline prices than conversely, as the coefficient on gasoline price is 0.52463 (table 6) and the one on ethanol price is only 0.16418 (table 5). Both coefficients are positive and significant at the 1% level. As they are two competing products, the correlation between their prices should indeed be positive.

The coefficients on the interactions between fuel prices and the percentage of flex cars are 0.00992 in table 5 and 0.00604 in table 6. Both are positive and significant at the 1% level. That is to say an increase in the percentage of flex cars augments the sensitivity of the price of one fuel to the price of the competing products. This is consistent with the interpretation of strengthened competition between gasoline and ethanol as the percentage of flex fuel rises.

Table 6: Regressions - Ethanol Prices

Dependent Variable: Ethanol Price

	(1)	(2)	(3)
%Flex	**-0.09798*** **	**-0.00952** **	**-0.01429*** **
	(0.00471)	**(0.00452)**	**(0.00481)**
(%Flex) . (Gasoline Price)	**0.03453*** **	**0.00436*** **	**0.00604*** **
	(0.00178)	**(0.00165)**	**(0.00176)**
Ethanol-Powered Cars	0.00643*	-0.02934***	-0.03073***
	(0.00341)	(0.00290)	(0.00284)
Ethanol Cost	0.59775***	0.32156***	0.31613***
	(0.00467)	(0.00423)	(0.00409)
Gasoline Price	0.41055***	0.54225***	0.52463***
	(0.00565)	(0.01121)	(0.00997)
Minimum Wage			-0.00024***
			(0.00006)
GDP per Capita			-0.00144***
			(0.00044)
(Total Stations)/(Ethanol-Powered Cars)			0.00002***
			(0.00000)
Hotels per km²			0.00358
			(0.03124)
Constant	-0.14403***	-0.07033***	0.05365***
	(0.02318)	(0.02462)	(0.01750)
Month Fixed-Effects	No	Yes	Yes
City Fixed-Effects	Yes	Yes	No
Brand and Station Fixed-Effects	No	No	Yes
Observations	151362	151362	150753
Number of Groups	2109	2109	2109

Robust standard errors in parentheses -
(robust to heteroskedaticity and to correlation of the residuals within a city in a given week)
* significant at 10%; ** significant at 5%; *** significant at 1%

The first two columns of each table present regressions that do not include all the control variables presented in the third one. As we can see, the inclusion of time dummy variables systematically reduces the coefficient on the percentage of flex cars in table 5, showing that in the specification number 1 the variable %Flex might be capturing a trend of gasoline price increase over time.

In general, the coefficients regarding other variables can be better interpreted according to economic theory on the regression that has gasoline as a dependent variable.

We expected the coefficients on minimum wage to be positive in both tables, since an increase in costs of the station should raise fuel prices. However, its signal is negative in the ethanol price equation.

We included the GDP variable because we believe there is a positive correlation between the percentage of flex cars and the average income per capita in each city. As the vast majority of flex cars are new, we expect that stock of this type of vehicle will be larger in cities that have been recently renewing their cars stock. This is more likely to occur in richer municipalities.

The coefficients on GDP per capita have negative signs and are significant at the 1% level in both tables. Although we expected these signals to be positive, these coefficients might be capturing the fact that richer municipalities are more competitive. This may be due to the fact that wealthier consumers are better informed about prices[6]. Polo (1991) builds a model of price competition in a duopoly a la Hotteling in which different types of imperfectly informed consumers coexist. The author concludes that if consumers are not well informed about prices, the equilibrium price tends to rise above the full information level. Nevertheless, Polo (1991) does not discuss if well informed consumers are richer or poorer.

To control for some level of competition among stations in each municipality, we created variables that represent the number of fuel stations per stock of vehicles of each fuel type. We believe that an increase in the number of stations per vehicles will result in more competition among retailers, i.e., we expect the coefficients of those variables to be negative in both gasoline and ethanol equations. Nonetheless, in the ethanol equation the coefficient of this variable has the opposite sign. Both are significant at the 1% level.

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[6] Here we are assuming that richer consumers are better informed, but this is not necessarily true. For instance, Marvel (1976) argues that richer consumers have a higher cost of time spent in searching to be informed about prices.

The inclusion of the variable Hotels per km^2 in the reduced model was made to add a proxy for tourist activity. We expected that fuel prices in tourist cities would be higher because tourists have a more inelastic demand, since they are less informed about local price levels and the location of competing gas stations. This fact would give some market power to stations in tourist cities. Indeed, the sign of these coefficients are positive in both tables, but it is significant only in table 5.