

The Impact of a Growing Ethanol Market on the Demand Elasticity for Gasoline in Brazil



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Summary



- Introduction
- National Ethanol Program
- Objective and Methodology
- Results
- Conclusion

Introduction



- The evolution in the use of energy resources and the dominance of petroleum
- Motivation for the introduction of biofuels:
 - Energy security
 - ✦ Price volatility
 - ✦ Political instability
 - Growing exploration costs of oil
 - Concerns about global warming
 - Developing countries:
 - ✦ Employment creation
 - ✦ Foreign exchange savings

Introduction



- Fuels Market in Brazil
 - Until the early 1990s:
 - ✦ Strong government intervention: price setting
 - ✦ Monopoly in oil exploration, refining and commercialization
 - Since 1995:
 - ✦ Liberalization: elimination of entry barriers and price ceilings
 - ✦ End of cross-subsidies
 - Ethanol Market: prices vary significantly across federal states
 - ✦ Production concentrated in 8 of the 27 states: transportation costs
 - ✦ Taxation across states is not homogeneous

National Ethanol Program



- Launch of the program: 1975
- Goal: reduction in the consumption of oil
 - Addition of dehydrated alcohol to gasoline
 - Production and use of hydrated alcohol fueled vehicles
- Evolution:
 - 1980s: the first expansion phase
 - ✦ Incentives: cross-subsidies and price ceiling, tax breaks and funding for R&D
 - ✦ Growth in demand and production: learning by doing
 - ✦ By 1985, 95,8% of the cars sold used hydrated alcohol as fuel
 - 1990s: liberalization of the fuel market and the decline in international oil prices
 - ✦ Dramatic fall in sales of ethanol fueled vehicles: by 1996, the number of ethanol fueled vehicles sold represented only 0,8% of the total car sales
 - Early 2000s: flexible-fuel vehicles
 - ✦ Increasing the substitutability between gasoline and ethanol
 - ✦ Near future: all cars sold should be flexible-fuel

National Ethanol Program



1975 -
1990

- Goal: fast increase in production
- Policy: purchase guarantees and price floor

- Development of sugar-cane varieties and agriculture techniques
- Improvement in the pressing system and fermentation process
- Energy self-sufficiency (biomass use)
- Final use: ethanol quality specification and E-100 engines

1990 -
2000

- Goal: efficiency gains and cost reduction
- Policy: end price fixing

- Logistic optimization: harvesting, loading and transportation of sugar cane
- Genetic transformation of the sugar cane
- Development of Industrial automation
- Improvement of managerial skills
- Energy surplus sale

2000 - ...

- Goal: advancing managerial techniques in production
- Policy: R&D

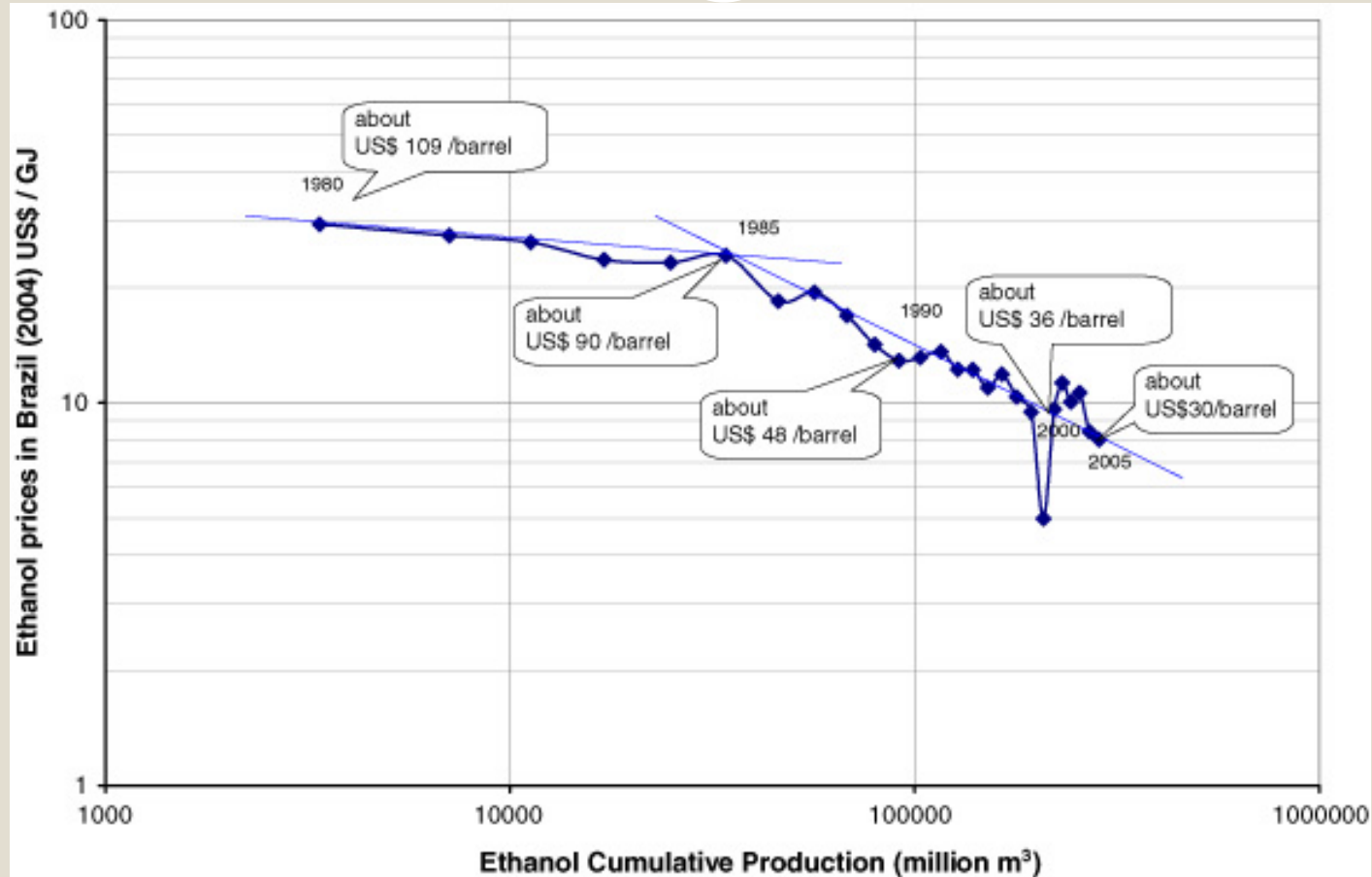
- Technical improvements generalization
- Greater agriculture precision
- Introduction of the flexible fuel technology
- Entrance in new markets (exports)

National Ethanol Program



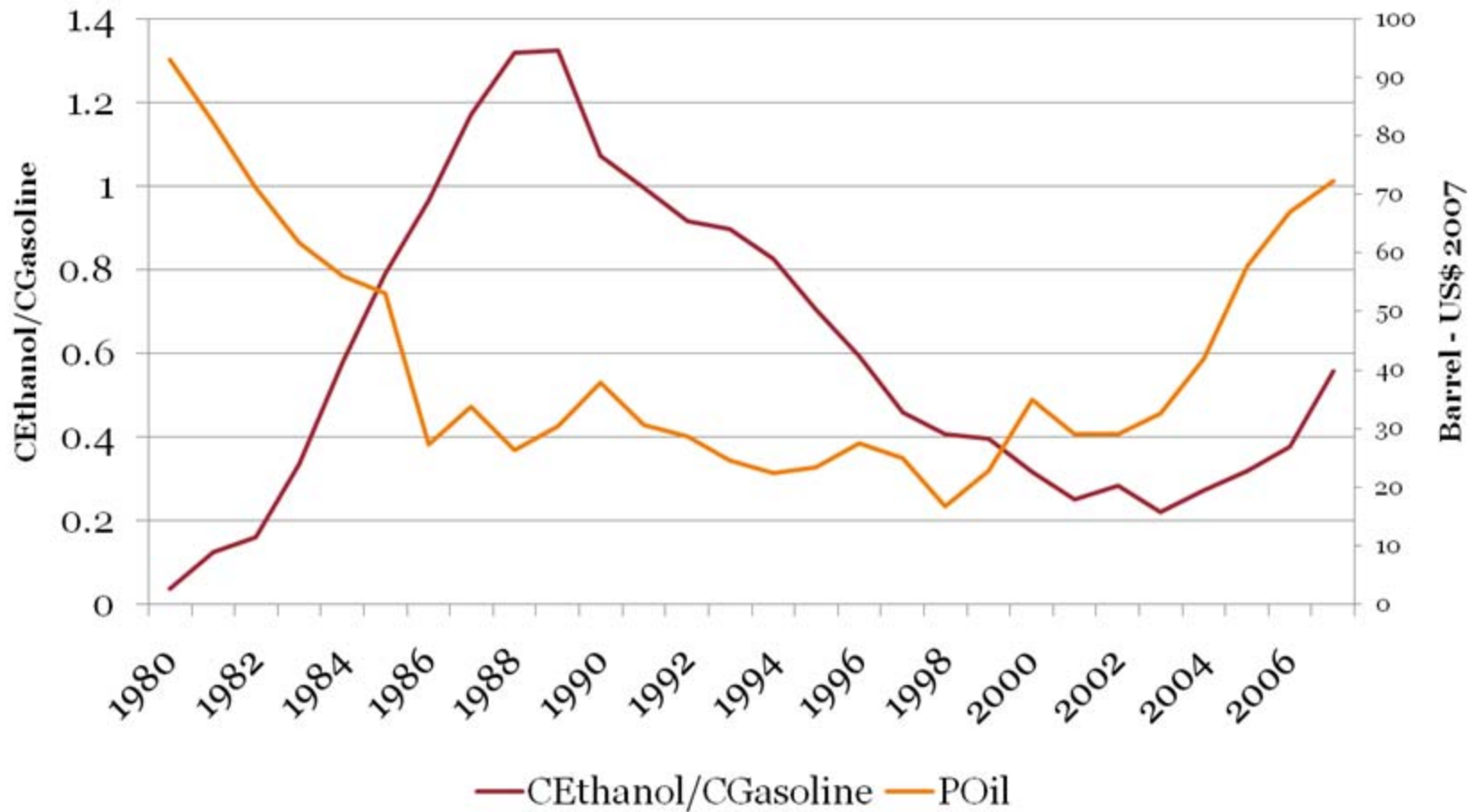
- Gains associated with the technology improvement:
 - Increased pressing capacity
 - Lower fermentation time
 - Increased fermentation and distillation yields
 - Significant improvement in total yields (from 66 to 86 liters of ethanol per ton of sugar cane)
 - Reduced vapor consumption
 - Greater surplus of biomass from the pressing of sugar cane
- Ethanol from sugar cane: best energy balance among biofuels with commercially available technology

National Ethanol Program



Source: Goldemberg (2006)

National Ethanol Program



Fonte: MME (2007) and BP (2008)

Objective & Hypothesis



- Goal: estimate the effect of the introduction of flexible-fueled engines on the demand elasticity for gasoline in Brazil
 - Existing studies: cointegration analysis with national averages pricing and fuel consumption data
 - The importance of federal states' non-observed specific effects
 - ✦ Ethanol prices vary significantly across the country: from as low as R\$0.007/liter to as high as R\$0.013/liter
 - ✦ State sales taxes on ethanol vary from 12% to 30%
 - ✦ Variation in gasoline price and taxation is much lower
- Hypothesis: the introduction of the flexible-fuel technology increased the elasticity of the demand for gasoline in Brazil

Methodology



- Quarterly panel data for the 27 states, between 2001 and 2006

$$QGAS_{i,t} = \alpha + \beta_1 PGAS_{i,t} + \beta_2 PETH_{i,t} + \beta_3 Y_{i,t} + \beta_2 QGAS_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

- GMM-SYS is estimated stacking the regressions in differences and in levels, with the following moment conditions applied to the first and second part of the system, respectively

$$E[(\varepsilon_{i,t} - \varepsilon_{i,t-1})QGAS_{i,t-j}] = 0, j = 2, \dots, t-1 \text{ e } t = 3, \dots, T;$$

$$E[(QGAS_{i,t-j} - QGAS_{i,t-j-1})\varepsilon_{i,t}] = 0, j = 2, \dots, t-1 \text{ e } t = 3, \dots, T.$$

Methodology



- Sample: 2001 – 2006 and 2003 – 2006
- Robustness:
 - Consistent estimator:
 - ✦ Serial Correlation (2nd order)
 - ✦ Validity of the instruments: Sargan Test
 - Alternative econometric methodologies

Descriptive Statistics



	Full Sample				Shorter Sample			
	PGAS	QGAS	PETH	Y	PGAS	QGAS	PETH	Y
Mean	0.016	70594.3	0.011	1519.92	0.015	71580.8	0.011	1578.78
Median	0.016	28676.1	0.011	1221.41	0.015	29585.9	0.011	1280.70
Maximum	0.019	650810.8	0.016	6203.32	0.018	612496.4	0.016	6203.32
Minimum	0.013	2954.7	0.006	427.69	0.013	3448.698	0.006	539.46
Std. Dev.	0.001	112288.9	0.002	934.107	0.001	111142.9	0.002	991.039
Skewness	0.248	3.454	0.032	2.247	0.314	3.373	-0.059	2.355
Kurtosis	2.652	15.738	2.966	9.831	2.710	15.162	2.983	9.910
# Obs.	594	594	594	594	405	405	405	405

Test Results



	Full Sample	Shorter Sample
C	-0.051*** (-4.558)	-0.103** (-2.238)
ΔPGAS	-0.945*** (-3.959)	-1.505*** (-3.725)
ΔPETH	0.049 (0.484)	0.611*** (2.521)
ΔY	0.154* (1.982)	0.370** (2.042)
ΔQGAS(-1)	0.135*** (4.348)	1.001*** (322.834)
No. Obs. (n)	592	403
Sargan Test (p-value)	0.565	0.147
Serial Correlation Test (p-value)	0.265	0.132

Previous Studies



	Short-run			Long-run		
	ϵ_{PGAS}	ϵ_{PETH}	ϵ_Y	ϵ_{PGAS}	ϵ_{PETH}	ϵ_Y
Burnquist and Bacchi (2002)	-0.319	-	0.600	-0.227	-	0.959
Alves and Bueno (2003)	-0.092	0.230	0.122	-0.465	0.480	0.122
Roppa (2005)	-0.073	-0.197	0.472	-0.634	0.402	0.164
Azevedo (2007)	-	0.364		-	1.301	
Nappo (2007)	-	-	-	-0.197	-	0.685
Present Study – Full Sample	-	-	-	-0.945	0.049	0.154
Present Study – Shorter Sample	-	-	-	-1.505	0.611	0.370

Concluding Remarks



- The introduction of the flexible fuel technology:
 - The price elasticity of the demand for gasoline
 - The cross-price elasticity of the demand for gasoline with respect to ethanol
- The importance of accounting for the states specific effects
 - Logistic costs
 - Taxation burden

Thanks!



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